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AMERICAN MAMMALS INTRODUCED INTO FRANCE IN THE CONTEMPORARY PERIOD, ESPECIALLY MYOCASTER AND ONDATRA

BY E. BOURDELLE

Of the many kinds of American mammals kept in the menageries and zoological parks in France, as well as in those of some other European countries, certain species gave evidences of a degree of adaptability which led to attempts to rear them for special purposes, as for example, to produce fur. Fur farming in France, however, was attempted mainly after the World War and especially from 1925 to 1928. The silver fox (*Vulpes fulva argentata* Shaw) was the first to find favor with breeders of fur bearers but was quickly followed, among carnivores, by the raccoon (*Procyon lotor* (Linnaeus)), American mink (*Mustela vison* Schreber) and striped skunk (*Mephitis mephitis* (Schreber)). Rodents included the muskrat (*Ondatra zibethica* (Linnaeus)), nutria (*Myocastor coypus* (Molina)), viscacha (*Viscaccia viscaccia* (Molina)) and the chinchilla (*Chinchilla laniger* (Molina)). Even the Virginia opossum (*Didelphis virginiana* Kerr) was tried.

These attempts at propagation had various fates; some were soon abandoned because they were unprofitable, but others, particularly those with *Ondatra* and *Myocastor*, for some time were extended, especially during the period when these animals were in great favor about 1930. Subsequently, raising them proved to be less profitable and efforts at propagation declined. However, fur farming of *Ondatra* has been definitely abandoned, although some *Myocastor* are still raised. Regardless of the success or failure of future attempts to "farm" these two animals, the experiments will have had an important zoological consequence by reason of having added two foreign rodents to the French fauna. It is this consequence that we wish to consider here, both in reference to the present status of the animals and their probable future.

MYOCASTOR

The ragondin or nutria (*Myocastor coypus* (Molina)) was introduced long before the muskrat. As early as 1882, Pays-Mellier (*Bulletin de la Société Nationale d'Acclimatation de France*) mentioned raising nutrias in captivity on his property, called the Pataudière at Champigny on Veude (Indre et Loire); and in 1885, in the same bulletin, he carefully described the requirements for breeding these animals.

In 1888 the "*Bulletin de la Société d'Acclimatation*" carried an account of the raising of nutria also by Edgard Roger in the park of the Château de Naudy (Seine et Marne).

In 1890–91–92, the "*Revue d'Histoire Naturelle appliquée de la Société d'Acclimatation*" mentioned the rearing of nutrias instituted by H. Sharlaud at Fontaine St. Cyr near Tours (Indre et Loire), and remarked on the perfect condition of these animals despite a rigorous winter.

Certainly other lots of nutrias existed at this period in different regions of France, as the private enterprises of amateurs, but were not especially observed nor reported in the literature. Undoubtedly most of these enterprises disappeared after the beginning of the war of 1914, and it was not until 1925 and especially 1927–28 that the animals were again extensively raised, in cages, in parks, and in semi-freedom. These enterprises were installed more especially in central and southwestern France, but there were also some in Brittany as well as in the east and north of France. The nutrias showed a wonderful faculty for adapting themselves to the diverse conditions in France; they accepted as food the varied resources of our soil, withstood the cold as well as the heat, and quickly demonstrated everywhere a normal rate of reproduction.

These attributes, and the commercial value of the animals' fur, greatly favored nutria propagation in France. Great hopes of financial success resulting from nutria breeding were held at this time. This is shown by the numerous articles which appeared in journals and reviews from 1928 to 1933: such as the "*Revue d'Histoire Naturelle appliquée*", the "*Bulletin de la Société Nationale d'Acclimatation de France*", "*Elevage et Fourrure*", and the "*Saint Hubert Club.*"

These great hopes were unhappily ended as a result of the world economic crisis, which in these last years has so greatly affected France. Although a few breeding colonies of nutrias have been maintained in the hope of a revival of the industry a great many have disappeared. Nevertheless, as compensating in some measure for the reduced number of captive animals, it is to be noted that a certain number are now living in good condition in the wild as a result of escapes from the parks where they were kept. These escaped nutrias occur in several parts of France but principally in the central section. This freedom appears to be favorable to them, for having easily

solved the food problem, they reproduce normally, and appear to be maintaining their numbers in the wild state. The future alone will tell if the ragondin has really found in France, a country of canals and old abandoned mills, a new home to its liking, and if this South American animal must be added to the list of the free-living rodents of our country. The possibility that the nutria will survive in the wild state and establish new colonies raises some questions of a utilitarian or economic kind as well as some of a purely zoological nature.

Although the nutria is of a submissive, gentle nature, at any rate timid, and although contrary to popular account, it is essentially a vegetarian, and is useful as an animal that prunes and keeps down vegetation in ponds, many people regard it as a predator and demand that it be treated as injurious. Up to now the French law has exempted the nutria from this category, and in the wild state he is subject to the general regulations applying to other game. That is to say, he cannot be killed except in the open hunting season, and then only by those who have regular hunting permits. Thus, in France the nutria benefits in the wild state by a relative protection and we hope that he will maintain himself and multiply so as to provide our country with a new and valuable game animal.

ONDATRA

The rat musqué, muskrat, or ondatra (*Ondatra zibethica* (Linnaeus)), introduced into Germany in 1905, at Dobrisch (formerly Bohemia) by Prince Coloredo Mansfeld, where it so quickly became celebrated because of the excessive rapidity of its reproduction in nature, its territorial extensions, and the damage that it did, was not introduced into France until after the war, that is to say much later than the nutria. Even if one found a few specimens here and there in zoological establishments, traveling menageries, or at the homes of some individuals, it was not until about 1927 or 1928 that fur farmers took up the raising of this animal. Madam L. Pereyrol was the first successfully to breed it in captivity, as set forth by her in "*Elevage and Fourrure*" for September, 1928.

The propagation of muskrats became popular in France. The relative ease with which breeding stock could be procured, the prospect initially of profitably rearing them in captivity, and the remarkable fecundity of these animals were the factors which encouraged many to undertake the raising of *Ondatra*. Numerous centers of propagation were established, but serious difficulties were quickly encountered. Whereas the nutria bred well when closely confined, the muskrat, on the contrary, showed little inclination to live under the same conditions, and did not reproduce well in captivity. To satisfy the biological requirements of this ungovernable rodent it was necessary to give it semi-freedom. Although under these conditions the animal

regained its prolificity, it also enlarged the list of items on its diet to an alarming extent; its entire biological activity was carried out in an exaggerated degree. Still more easily than the nutria, and in far greater numbers, the muskrat escaped from the parks where it was propagated and invaded the neighboring regions. It spread out rapidly, as much in the water as on land, and especially under ground gave evidence of its presence by an endless variety of activities that were injurious to man. Without doubt it can be believed that quite different geographic varieties were introduced into France and that these did not all adapt themselves in the same way; some even may have given rise to new forms.

Changes in the habits of *Ondatra* introduced into France had been noted by the breeders as early as 1930. E. C. Lafond in the March number of the journal *"Elevage et Fourrure"* for that year pointed out that, in Europe, the muskrat had very rapidly changed its habits and, to the contrary of what it had been in America, except locally, in our country had become extremely noxious from all points of view. This actual noxiousness, which was perhaps a little exaggerated, brought the muskrat into disrepute, and thus compromised the future of its propagation as a fur animal. At the same time the increasing number of animals found in the wild, led to fears of an expansion in France comparable to that which had occcurred in Bohemia after 1906, where in a few years thousands of the animals radiated out into Austria, Bavaria, Saxony and Thuringia.

After the first capture of *Ondatra* in the wild state, recorded in 1930 at Grenoble by Piraud (*"Procès verbaux de la Société dauphinoise d'études biologiques,"* for March 23, 1930), Regnier (*"Bulletin de la Société des Amis des Sciences Naturelles de Rouen"* for April, 1933) noted new captures in the departments of the Eure and Lower Seine. In 1934, A. Chappellier, Director of the Service of Injurious Vertebrates, of the National center of Agronomical research of Versailles, in the March number of the *"Bulletin de la Société Nationale d'Acclimatation"* gave an account of the captures of free-living muskrats in France up to that time, presented a map showing their distribution in the wild state, and inaugurated a drastic campaign against the animal.

Twelve centers of infestation were recognized in 1933. Five were grouped in the basins of the Seine and the Somme, and concerned the departments of Eure, Somme, Seine, Oise and the Lower Seine. The last department was the most heavily infested, having two important centers. Four centers were recognized in eastern France, one in the Department of Ardennes, another in the Meuse at the limits of the Belgian frontier, a third in the Department of Meurthe et Moselle, and a fourth in the Territory of Belfort. Finally three others were located in the center of southeastern France, in the departments of Allier, Loire and Isère.

In the Department of Eure, the Territory of Belfort, and the departments of Doubs and Upper Rhine the damage was particularly marked. The ma-

terial destruction wrought by burrowing in banks, dikes and ponds, and the well known tendency of the muskrat to eat fish caused concern to societies of fish culture, scientific societies, administrative offices, and to the State. From this time on the importation and breeding of muskrats in France was rigorously forbidden, and an active campaign was organized against the wild populations by trapping and by the use of virus. The infestations in the departments of Allier, Loire, Isère, Seine, Oise, and Lower Seine were destroyed, and there the muskrat can now be considered as extinct. The populations in Somme, Ardennes, Meurthe et Moselle and in the Territory of Belfort, although greatly reduced, persist still along the length of our eastern frontier and perhaps have already reestablished themselves in that general neighborhood.

At this writing the situation in France relative to the invasion of *Ondatra* is certainly much less grave than that in central Europe. One must recognize, however, that in spite of the positive results already obtained in the campaign undertaken against this animal, its complete extinction will be impossible, and that even more certainly than in the case of the nutria, the *Ondatra*, at least in eastern France, is here to stay. Although this animal species is not yet legally recognized as injurious, that is to say it is not on the list of so-called injurious forms, the heads of departments have, nevertheless, the power, at any time that it appears to them to be necessary, to recognize the muskrat as such and to authorize its hunting at all times and places.

This paper was read by P. Rode at the 20th annual meeting of the American Society of Mammalogists, July 20, 1938, at Berkeley, California.

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A PROGRESS REPORT ON SOUTHEASTERN MAMMAL STUDIES

By E. V. Komarek

My interest in ecological studies of mammals in the Southeast began in 1928 while I was with the Chicago Academy of Sciences. It has continued unabated under the Cooperative Quail Study Association, and has resulted in the trapping and examining of more than ten thousand mammals of over one hundred species in the South. This report constitutes a brief account of the progress of this work.

In recent years subjects have had to be considered which at first seemed far away from the realm of mammalian ecology. The first of these is the realization that the South has been so profoundly affected by man that it appears to be impossible properly to evaluate present-day ecology without taking human influence into consideration. It has been a common practice among mammalogists to make a sharp distinction between the ecology of man and that of the animals man has introduced and that of the so-called native fauna. To me this practice now seems impossible; for the ecology of our native animals is very closely intertwined with that of man. This is true not only of the direct relationship of predator (man) and prey (other mammals), but of the effect that man and his domestic animals have had on environments, not to mention man's introduction of diseases, parasites, and other factors that have influenced the native fauna.

The white man began to influence the fauna of the southern United States before his occupation of that part of America. When our first settlers arrived they found the Creeks and related tribes in possession of the deep South. These tribes, it now appears (Swanton, 1932), were originally Mexican tribes driven northward by the Spanish Conquest of southern Mexico, and they had already subjugated the earlier aborigines. They came from a primitive but highly developed culture and were predominantly agricultural. When the fertility of their large cleared fields failed or weeds encroached, they moved on and cleared more. Thus, even when the first white man appeared in the South, cotton rats (*Sigmodon hispidus*), oldfield mice (*Peromyscus polionotus*), and other present-day field-inhabiting rodents already had occupied many man-made habitats.

With the realization of the profundity and complexity of the influence of man—white, red, and black—my ideas have had to change. Not only must present-day conditions be studied, but also the circumstances that brought such conditions about. The following are several approaches to these problems:

1. The establishment of comparable quadrats or areas of study in the few remaining parcels of virgin wilderness (virgin only in the sense that much of the original vegetation remains), and also in areas definitely man-dominated. Already we are finding differences in such areas. For example, we have

found that the mammal composition in a virgin longleaf pine forest is decidedly different from that of an area which has gone through an agricultural period but is now again covered with pine.

2. The search through early literature and written material in related fields. Some of our most valuable sources of information are in military reports, survey reports, and diaries, as well as in the writings of early naturalists.

3. The compilation of censuses of man and the animals he introduced and the attempt to estimate the effect some of these have had on natural vegetations and soils.

4. The study of our mammals today, both native and introduced.

There are other factors besides man of great importance in the South. The range in elevation is from sea level to nearly 7000 feet. The soils range from some of the oldest on the American continent to some of the youngest, such as those of the Coastal Plain. Zon (1924) mentioned that four-fifths of the original forest of the United States was in the East. A great deal of this was in the South. Of the seven main forest divisions in the East six occur in the South, as follows:

1. Spruce-fir (northern coniferous forest) in the higher parts of the Appalachians.

2. Birch-beech-maple-hemlock (northeastern hardwood forest) in the Appalachians.

3. Oak (southern hardwood forest). "This hardwood forest is probably the largest hardwood forest in the Temperate Zones of the world." (Zon, 1924).

4. Cypress-tupelo-red gum (southern river forest).

5. Longleaf-loblolly-slash (southeastern pine forest). This forest type formerly covered the greater portion of the lower South.

6. Mangrove forest.

The climate ranges from Canadian in the Appalachian mountains to subtropical in southern Florida; the yearly average of precipitation varies from 40 inches to over 100 inches.

One factor that is commonly considered man-created, but in the South must be considered a natural factor, is fire. The Southeastern pine forest and associated vegetations were apparently created by this agency and cannot exist naturally without it. (Forest Service 1938, Wells 1932.) In this region mammalian ecology cannot be studied without one's being impressed by the great importance of fire: not only are certain plant associations dependent on it, but the occurence and distribution of certain animals as well. Some mammals tend to have much more of a burrowing habit through the Southern pine belt than in other sections in the South. The influence of fire has been strikingly demonstrated to us at Sherwood Plantation, where for the past four years we have had an experimental area set aside for mam-

mals. Within the space of this four years the mammal population of some of our quadrats changed greatly, both in species and in individuals, *where no fire occurred*. Plant succession was so rapid that we had to institute burning as an agency whereby we could retain certain mammals within our area.

Thousands of acres of burned lands (both control burned and where so-called disastrous fires have swept) have been searched for mammals killed by fire—and with practically no success. Among other experiments we burned a four acre field where there was known to be a large population of cotton rats and stationed men around the fire line to catch those that ran before the fire. Later the burn was very closely examined for dead rats, but none was found. The field was then plowed—and the rats were found alive in their burrows. There has been much propaganda in the South as to the destructive effect of fire on mammals, both large and small, but no proof by any scientific agency. It now appears that fire is only one of many natural factors that play a part in the lives of our native mammals.

As previously reported (Komarek 1937), these studies can be roughly divided into two broad phases; which, however are closely interwoven. First, the intensive or experimental studies, carried out largely between Thomasville, Georgia, and Tallahassee, Florida; and second, the extensive studies, or field work, carried on in the Southeast generally. To a great extent one type is used to check the other.

Thus, in connection with studies of cotton rats and other rodents, experimental areas have been set aside on which the mammals are periodically trapped, consecutively numbered, weighed, examined roughly for parasites, sex and other data recorded, and released. We also have the opportunity to check such notes by observation and trapping generally through the Southeast in connection with our Quail Study Association work.

The distribution of mammals has been of much interest to us. In a report on the mammals of the Smoky Mountains (Komarek & Komarek, 1938), mention was made of the fact that the mammals occurring there could be arranged in three series, based on present distribution and on affinities with species in other sections of North America as follows:

1. Those with northern affinities.
2. Those with southern affinities.
3. Those of widespread distribution.

This appears to be applicable not only to that region, but also to the Southeast as a whole, with the possible addition of another group represented by the pocket gophers and related to western species.

With the added impetus to game and other wildlife restoration there is much interest in those mammals that prey on other animals. One of the most controversial questions has been the food habits of the gray fox (*Urocyon cinereoargenteus*), mainly because it is the object of sport as well as a predator.

In 1937 I wrote: "There are entirely too many ecological complexes to be able to make a life history study of an animal such as the fox in a short time. Food habits of foxes determined from stomach contents collected everywhere, largely in winter, and without any knowledge of game animals where the predator was taken, cannot be considered as proof of food-inter-relationships with upland game."

I wish further to emphasize those statements, for nearly four hundred fox stomachs have been taken during the last four years from areas where I am familiar with conditions; all that can be said is that foxes can and do harm to quail populations at certain times and under certain conditions, but under other conditions the reverse is true. I feel that premature publication, and publication of studies based on insufficient data, without due regard to seasonal or cyclic conditions, to the other animals in the environment and to the conditions of the land, have caused a great deal of misunderstanding and have done much harm.

In our studies of the gray fox we have learned that foxes have definitely harmed quail populations. (As many as eleven hatching quail and three young quail have been found in one stomach.) The first year of our work the remains of quail eggs or young quail were found in more than 25 per cent of the stomachs examined. However, the percentage has not been so high since, and in one year was only about 3 per cent. If we had released our data at the end of the first year and then stopped we would have unqualifiedly condemned the gray fox; but now that we are entering the fourth year of these studies all we can report is that sometimes the gray fox can damage quail and that at other times it apparently does not.

Caution must be used in the evaluation of the remains of animals in front of fox dens, because these remains apparently do not necessarily represent an index to food habits. In 1937, through the cooperation of the late Roy Rogers, seven red fox (*Vulpes fulva*) dens were dug out in Georgia at great trouble and expense, for one den was 47 feet long and the nest was 14 feet below the surface. Rabbit skins, much worn and dirty, were found at the entrances of all these dens. This appeared to indicate that the foxes were feeding on nothing but rabbits. Yet, in six out of the seven dens the freshly killed remains of quail were found. Might not the "food evidences," or rabbit skins found at den entrances, simply be "playthings" for fox puppies?

I believe that no eradication or control program for foxes should be considered at present. This problem is so complex that conclusions cannot safely be drawn without more study than has yet been made.

The skunk (*Mephitis mephitis elongata*) is another mammal that has come in for a great share of attention, but, because it is not the object of sport and has little sentimental value, it has few defenders. Here again we have found, as in the fox study, that stomach contents vary with the seasons, years, and with environment. We have data to show that at times this animal can be

destructive to ground-nesting birds such as quail (Stoddard, 1931). It should be emphasized, however, that a mammal need not be classified categorically as good or bad; conditions and circumstances account for its behavior at a particular time and place.

One big difference between the predation of hawks and owls as contrasted with that of mammals, as often mentioned by Stoddard, is that mammals are able to cause, and apparently do cause, harm to such ground nesting birds as quail because they feed on eggs, hatching young, or very young birds, while the winged predators kill largely only the well grown young or adults. The most vulnerable period in any animal's population is the breeding season.

The effect of mammal predation, as well as that of hawks and owls on mammals, is being studied, but no definite conclusions can be drawn at the present time.

Stoddard (1931) has shown that cotton rats can destroy quail nests, but here again we are finding that only under certain conditions are they very destructive to quail populations.

As a practical management measure we find that it is only necessary to keep the land from becoming optimum cotton rat habitat, largely by the use of fire. Under such conditions the cotton rat predators are able to keep the rat population within, one might say, normal bounds. Fire seems to be a natural factor in keeping balance insofar as rodents and predators are concerned. More and more it appears that in the South, where predators of quail are concerned, whether rodents or larger mammals, the use of fire is the key to a balanced normal population. It should be realized, of course, that this balance is in a constant state of flux.

On our experimental area on Sherwood Plantation in Grady County, Georgia, the rodent population changed with plant succession. As the major problem in most of this area was a cotton rat life history study, management had to be instituted and part of the area maintained in open field and open pine woods, but with denser ground cover than necessary for quail. In the absence of fire the cotton rats were being replaced by other rodents. In one of our quadrats in an open pine woods with a broomsedge and herbaceous ground cover we had a fair population of cotton rats. This area was then protected from fire for four years. As the ground cover changed to low bushes and tangles of vines the cotton rat population decreased, although on check quadrats it did not. At the same time the golden mice (*Peromyscus nuttalli*) and cotton mice (*Peromyscus gossypinus*) increased. The same changes occurred in old sedge, which, in the absence of fire, began to be replaced by dense growths of young pines and deciduous bushes. It was remarkable how rapidly this transition took place.

Thus it is that fire not only keeps rodents from becoming too abundant, as previously mentioned, but to some extent it is also necessary for their welfare. Apparently we not only have mammal successions, but there may

be certain climax types comparable to those in plant ecology. At one time I held a different opinion; but it now appears to me that there is a definite, although complex, correlation between plant succession and a coincident mammal succession. To study this further we are setting up an area beginning with a corn field in cultivation. Here we intend to allow plant succession eventually to turn it into a wooded tract. Part of this area will be burned.

Among other things, we have learned from our experimental areas that cotton rats increase with the density of sedge and certain other low growing vegetations, but they also gradually decrease in the absence of fire; that oldfield mice become more abundant in first and second year fallow cornfields or thin sedge; that golden mice supplant both of the foregoing species when small trees and vines encroach on such areas; and that cotton mice also begin to enter these areas at the same time. They remain in such areas even though these are wooded and burned, while golden mice apparently are dependent upon brushy growths.

In one of our areas, on Tall Timbers Plantation in Leon County, Florida, we had a high population of house mice (*Mus musculus*) and oldfield mice. The house mice disappeared within a few days after the quadrats were burned, whereas no change occurred in the population of the oldfield mice. Immediately after burning, the area was searched for dead mice, but none was found. However, a shrike was seen to catch one of the banded house mice, and a red-shouldered hawk and a sparrow hawk remained on the burned over area for several days. In the course of our work it has been strikingly demonstrated to us many times, as Stoddard has often pointed out, how quickly hawks are attracted to a fire. It is interesting to note that the exotic house mouse suffered, while the native species was apparently well adjusted to this factor. Fire likewise kept the plant succession at the stage of an open field.

A record is kept of the localities in our quadrats where the mammals are trapped. This has yielded a great deal of information, not only about numbers, but also about movements. In cotton rats, cotton mice, oldfield mice, and golden mice there appears to be a large, rather sedentary population. Of the four, the cotton rat ranges most, the golden mouse least. The movements or ranges of these rodents is very similar to human populations in several respects.

Territories for individual rodents are difficult to define, for they apparently change greatly during the year. The numbers of rodents in any quadrat changes quite drastically, somewhat as a yearly cycle, which, in the case of the cotton rat, becomes lowest in spring. At this time the ratio of sexes apparently levels off, as if to indicate some "pairing" tendency among the rats, while at other times there may be a preponderance of males or of females in the areas. The period in the cycle may have something to do with this. The cotton rats have not, apparently, again reached as high a point in their cycle as they did in 1934. Neither have we found the rodents as large in size

as we did then in areas checked in Alabama, Mississippi, Georgia, Florida, and South Carolina—with one exception. At Hilton Head Island, South Carolina the composition of the cotton rat population in August, 1938, was much like that outlined in 1934. In March, 1939, it had changed and was similar to that on the mainland in South Carolina, as well as at Sherwood Plantation. Since 1934, with this single exception, the cotton rat population wherever checked in the south has consisted of rather small individuals.

The parasites, and to some extent the diseases, of mammals have been of much interest to us; we are finding that the parasite population of mammals varies with conditions and localities. Thus, B. V. Travis and I have found that cotton rats in certain areas along the west coast of Florida are heavily infested with a filaria or heartworm that we have not succeeded in finding elsewhere. Again, the occurrence of pentastome larvae in *Peromyscus gossypinus* has been found to vary within short distances. For example, near St. Marks, Florida, the *Peromyscus* in certain "bays" are heavily infested, while those in others nearby are free. This infestation of parasites, both internal and external, has such a "spotty" distribution that we have found it impossible to work out satisfactory percentages of infection for any group as a whole. Apparently so many mammals would have to be examined from any one region that it would be almost a hopeless task.

In our experimental areas we found that on cotton mice, golden mice, and pine mice, the population of ticks and red bugs increased when certain quadrats were not burned; yet the parasite population did not increase on the same rodents in burned areas. So again it appears that fire plays a part in the ecology of Southern mammals, and not necessarily a detrimental one.

In conclusion I wish to emphasize that, although many data have been gathered on various aspects of mammalian ecology in the South, much more has to be learned before sound interpretations can be made.

This paper was read at the 21st annual meeting of the American Society of Mammalogists, April 6, 1939, at Baton Rouge, La.

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FIFTEEN MONTHS OF BEAVER WORK AT ALLEGANY STATE PARK, N. Y.

BY ALBERT R. SHADLE and THOMAS S. AUSTIN

In a recent article, "A study of beaver colonies in Michigan," Bradt (1938, p. 154) points out that few accurate data have been published regarding the amount of food material required by beavers in the wild. He suggests that it is necessary to know, (a) exactly how many beavers were present during a definite period of time and (b) the number of trees cut during that period.

In the summer of 1937 a pair of beavers came into the upper part of the valley of Quaker Run in Allegany State Park, New York, and settled in a burrow beside the stream. The location was half a mile above Quaker Lake, beside which the Allegany School of Natural History is located. By the middle of August, 1937, a small amount of mud and a few sticks had been piled directly above the beaver burrow, at the foot of a large soft maple tree. Three or four dams, none more than eight feet long, had begun to impound the water at this point. Little construction had been accomplished, and no pictures of the work were taken at that time.

On August 11, 1938, a year after the beavers had taken up their residence, the zoology class at the Allegany School of Natural History assisted the senior author in making a survey of the colony. He wishes to express here his appreciation and thanks to the members of his class for their enthusiastic efforts in collecting part of the following data.

On November 11, three months after the first survey, the authors again visited the beaver colony to map the area and see what preparations had been made for winter. In the August survey, the area was thoroughly covered; the kind of each tree cut was noted and its diameter and circumference were measured with a logging tape. Owing to the muddy condition of the water, it was impossible to get a complete count of those stumps that had been covered by the impounded water, so that the numbers below represent an approximate minimum of trees cut rather than the exact number. The count

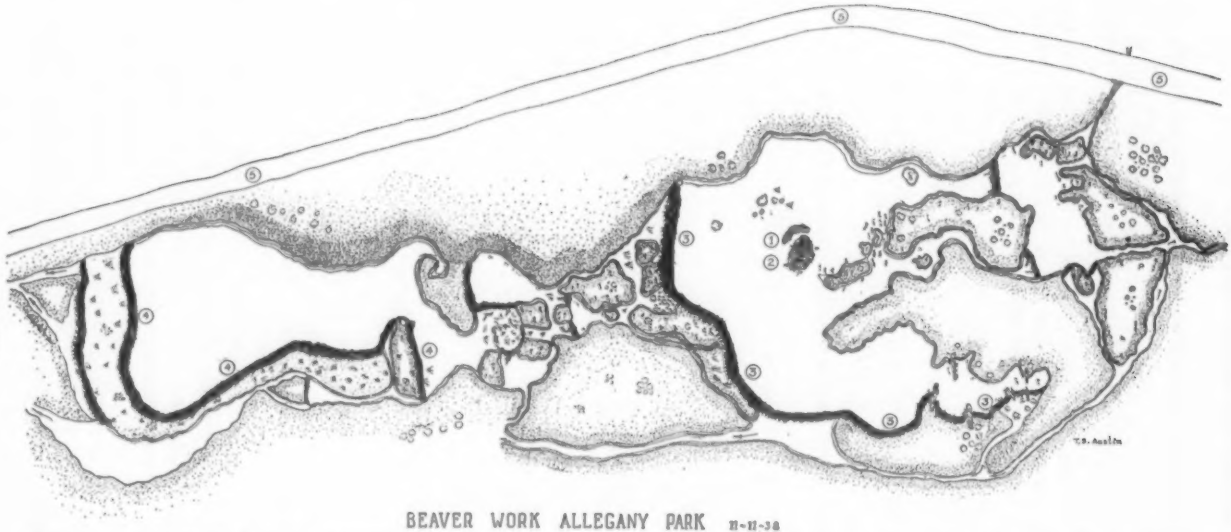

FIG. 1. The map shows the general arrangement of the dams and other work of the beavers on November 11, 1938. The partially exposed (1) pile of stored branches of winter food (poplar, willow, etc.) is located only a few feet from (2) the beaver house. Below the beaver house lies (3) the longest and highest of the dams. There are incorporated in this dam four very large, old, rotting hemlock logs, which lie at right angles to the face of the dam.

Within a few days after this November survey, the beavers had raised the lower dams (4) high enough to flood the road (5) which runs parallel to the stream.

does not include a considerable quantity of willow brush from five to eight feet high that was cut from the low ground covered by the water. Because it was impossible to get any accurate count of these willow cuttings, they do not appear in the table. Only specimens of an inch or more in diameter are included.

During the first year of occupancy a lodge was built around a large, living, soft maple tree directly in the center of the house. The tree was about ten inches in diameter at the base. The lodge measured 20 feet in east-west diameter, and 18 feet in the north-south diameter and was exactly 5 feet in height. At least two beaver kits were produced this year for they were seen once and at other times were heard in the house.

The building of the dams showed great activity (fig. 1). The work during the first year resulted in the building of thirteen pieces of dam varying in length as follows: 208 feet (below lodge), 206, 78, 60, 28, 27, 20, 16, 16, 16, 13, 11, and 6 feet, and making a total of 705 feet of dam. The highest point of a dam was three feet. In these dams greater use was made of rotten hemlock than the senior author has ever seen elsewhere. These rotten logs were torn to pieces and carried, dragged, or floated to the dam where they were used along with the fresh material.

During the three months following August 11, 1938, the total length of dams was increased approximately 150 feet. The 208 foot dam of August 11 measured 334 feet on November 11, and it had been raised six inches along the entire length. The house had been considerably increased in size. Its measurements on August 11 of 20 x 18 feet in diameter and 5 feet in height had been increased by November 11 to 26 x 24 feet in diameter, and 5 feet 9 inches in height. The volume of the house structure had increased from 472 cubic feet to 940 cubic feet.

The following table shows the number of each kind of tree cut. The numbers of each kind of tree, arranged in groups according to their respective diameters, give an idea of the requirements of these beavers. The first column of figures under each generic name gives the number of trees cut by the original pair of beavers during the first year, that is, up to August 11, 1938; the second column represents the cutting during three months, from August 11 to November 11. This last work was doubtless participated in, to some extent, by the beaver kits.

A count was made of the felled trees that the beavers were unable to utilize. Six trees measuring in diameter, 5.3, 5.8, 6.5, 6.8, 8.5, 10.0 inches had fallen so that they lodged in standing trees and could not be reached by the beavers. This loss represents only 2.3 per cent of the total numbers of trees felled. Many of the other larger tree trunks still lay where they had fallen; and the inability to use these larger pieces, when water is not available to float them, often results in a considerable loss of materials for food and building. Bailey (1929) has discussed the importance of loss of material in this way.

A pile of winter food materials, mainly poplar and willow, was stored along the north side of the house and a few feet from it. The food materials were almost entirely submerged. They formed a pile 30 feet long, 8 feet wide, and 3 to 4 feet deep.

It is interesting to compare the number of trees cut during the first year with those cut during the three months from August 11 to November 11, 1938. We find that 150 trees were cut during the last three months, or 34 more than during the entire first year. Only two beavers fed during the first

DIAMETER IN INCHES	POPULUS	AMELANCHIER	CARPINUS	PRUNUS	ACER	SALIX
1.0 to 1.9	17 25	7 5	7 3	1 1	1 —	— 3
2.0 to 2.9	21 32	5 5	9 1	2 1		
3.0 to 3.9	11 19	1 3	1 2	—		
4.0 to 4.9	5 13	3 3		1		
5.0 to 5.9	6 11	1		—		
6.0 to 6.9	7 6			1		
7.0 to 7.9	5 4					
8.0 to 8.9	1 2					
9.0 to 9.9	1 4					
10.0 to 10.9	2 2					
11.0 to 11.9	— 2					
12.0 to 12.9	1 —					
13.0 to 13.9	1 —					
14.0 to 14.9	—					
15.0 to 15.9	1					
Trees cut 8/11/38.....	78	17	17	3	1	= 116
Trees cut 8/11 to 11/11/38..	121	16	6	4		3 = 150
Total trees cut.....	199	33	23	7	1	3 = 266
Partially cut 8/11/38.....	2			3	1	= 6
Partially cut 11/11/38.....	6					= 6

year, and at least four will feed on the materials collected for the winter of 1938–39.

When the felled trees are listed in the order of their numerical and quantitative importance they rank as follows: *Populus tremuloides* and *P. grandidentata*, 199, or 71 percent of the total number cut; *Amelanchier canadensis*, 33; *Carpinus caroliniana*, 23; *Prunus pennsylvanica*, 7; *Salix*, 3; and *Acer rubrum*, 1. If all of the small *Salix* under one inch in diameter were included, *Salix* would rank second as a food material. It was also used in the building of the dams and the house. Since practically all of the willow cuttings had been covered by water, it was impossible to get any definite idea of the amount of this small brush that was being used.

Bradt (1938) says of beaver food preferences: "The aspen group, the maples, and the willow seem to be preferred in the order given." Bailey (1927) lists the beaver preference: "Poplars, willows, birches, pin cherries, alders, and the bush maples." The order of preference shown by our beavers is *Populus*, *Salix*, *Amelanchier*, *Carpinus*, and *Prunus*. It is evident that the maples and birches, although present, were not much used; but the ironwood (*Carpinus*) was frequently used. At a second colony in Allegany Park, the ironwood had been cut in considerable numbers.

CONCLUSIONS

The first year two adult beavers accomplished the following:

(1) Cut 116 trees from 1 to 13 inches in diameter.

(2) Built two dams, each over 200 feet long and a total of 705 feet of dam.

(3) Constructed a house with a volume of approximately 472 cubic feet.

During the three-month period from August 11 to November 11, 1938, two adult beavers and two kits accomplished the following:

(4) Cut 150 additional trees from 1 to 15 inches in diameter, a grand total of 266 trees.

(5) Besides their other damming operations they built an additional 150 feet of dam and raised the height of the longest dam six inches along its entire length.

(6) Increased the volume of the house from 472 to 940 cubic feet.

(7) Collected and stored a winter's supply of branches. The pile measured 30 feet long, 8 feet wide, and 3 to 4 feet deep.

Other points of importance were:

(8) Ironwood (*Carpinus carolinana*) made up nearly 9 percent of the number of trees cut, and *Populus* 71 percent.

(9) The loss from improperly felled trees that lodged in standing trees was only 2.3 percent of all trees cut.

(10) The order of preference of trees was: Poplar, willow, shadbush, ironwood, and pin cherry.

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SOME OBSERVED EFFECTS OF STREAM-VALLEY FLOODING ON MAMMALIAN POPULATIONS IN EASTERN OKLAHOMA

By W. Frank Blair

A recent article by Joseph Grinnell (Jour. Mamm., vol. 20, pp. 62–64, February, 1939) on the 'Effects of a wet year on mammalian populations' in northeastern California prompts me to record somewhat similar observations that I made in eastern Oklahoma in an entirely different biotic province.

The spring of 1935 was extremely wet in Oklahoma and adjoining states. The amount of precipitation was far above normal for that period, and most of the streams in northeastern Oklahoma overflowed their banks and consequently covered virtually all of their respective flood-plains for a period of several weeks. The flood-plains of Bird Creek and Verdigris River in Rogers County, Oklahoma, and the adjacent uplands were trapped at various intervals from the time the water subsided in about mid-June until September 7. Traps were set (for a total of 255 first trap nights) in the previously-flooded oak—elm association of the flood-plains on 7 nights scattered through the summer. During this time only one mammal, a wood-mouse (*Peromyscus leucopus noveboracensis*), was taken. This individual, however, was caught within the distance of a wood-mouse home-range of a wooded and unflooded slope, occupied by wood-mice. In addition to my trapping work, I spent two days, July 20 and August 1, in turning logs in the oak—elm assocation on the flood-plain. This method of collecting ordinarily would have yielded several wood-mice, many specimens of the pine vole, *Pitymys nemoralis*, (which is usually the commonest terrestrial mammal in the oak—elm association) and some specimens of the Carolina shrew (*Blarina brevicauda carolinensis*). Not a mammal was seen, however, and only one empty, recently-made, mouse nest was found. This was discovered at the base of a wooded slope that had not been flooded. A few tunnels of moles (*Scalopus aquaticus intermedius*) were found on the flood-plain during the summer, but most of them were near the outer edges of the flood-plain. A part of the moles probably escaped to higher ground when the flood-plain was inundated and later reoccupied the area, as the species normally is so rare in the ecological associations adjoining the flood-plain that it would be hard to believe that the post-flood invaders of the flood-plain were supplied by the normal population of the adjacent associations. It is somewhat surprising that the populations of the semi-arboreal wood-mouse were so adversely affected by the flooding. It seems likely that some individuals would escape the waters by taking refuge in the trees, and it is surprising that there was not an invasion of the area by wood-mice from contiguous, wooded, upland associations. The combined effects of the flooding and the extreme summer drought that followed killed most of the herbaceous vegetation of the flood-plain, and it is possible that this temporary, unfavorable, alteration in the oak—elm association discouraged later invasions by wood-mice from nearby associations.

An area of the flood-plain of Bird Creek in Mohawk Park, Tulsa County, was protected from flooding by a dyke. In 6 nights of trapping (310 trap nights) in late August and early September, 15 wood-mice were taken in the oak—elm association there. This indicated that the population of wood-mice on the unflooded area of the flood-plain was about normal. No trapping was done in the particular situation in which the pine vole and Carolina shrew generally occur; but O. W. Letson, the park naturalist, informed me that he saw several individuals of each of the two species in the park during the summer and autumn of 1935. Moles were abundant in the park during the summer and several were collected. On the whole, the populations of terrestrial mammals on the unflooded areas of the flood-plain appeared to be more or less normal; they did not show the great reduction that was observed in the areas that had been flooded.

Field work was again undertaken in the same region during the summer of 1936, after a normal spring, so there was some opportunity to determine the extent to which the populations of small mammals had recovered from the flooding of the previous spring. Pine voles, wood-mice, and Carolina shrews were trapped without difficulty in the dyke-protected area in Mohawk Park. However, several attempts to collect small mammals by turning logs in the areas of flood-plain that had been flooded in the spring of 1935 were unsuccessful. This method of collecting does not give a reliable test of the abundance of the wood-mouse, as the species also nests in trees, but it is a reliable test of the abundance of the terrestrial pine vole and Carolina shrew. As no pine voles or Carolina shrews were obtained it is believed that the population of these species had not yet recovered from the effects of the flood. In an area such as the Bird Creek region the effects of a flood like that of 1935 presumably would have a disastrous effect on the populations of the pine vole and Carolina shrew. The mesophytic ecological associations to which these forms are almost completely restricted are limited to the flood-plains of the streams. When these flood-plains are inundated any survivors will be forced into the strip of dry oak—hickory association or the grassland associations bordering the flood-plain. It is highly doubtful that they could survive in these unfavorable associations. Therefore, it is quite possible that, as a result of the flooding in the spring of 1935, much of the flood-plain will be devoid of pine voles and Carolina shrews until individuals have worked their way along the stream valley from some unflooded area such as that in Mohawk Park.

Unusually heavy rainfall in the spring of 1938 caused many streams in southeastern Oklahoma to inundate their flood-plains. A brief trip through the area was made in June of that year. One night of trapping with approximately 250 traps was done in the cottonwood association on the flood-plain of the Red River about 3 miles southeast of Yuba, Bryan County. Masses of driftwood and other debris, lodged in the lower branches of the trees, indicated that the area had been severely flooded. No mammals were taken

in the regular trap lines. Several mole tunnels were seen, however, and one mole (*Scalopus aquaticus pulcher*) was trapped. One cottontail (*Sylvilagus floridanus alacer*) was seen and collected, and one jackrabbit (*Lepus californicus melanotis*) was observed. No other terrestrial mammals were seen there. Two nights of trapping (400 first trap nights, divided equally between a dense lowland thicket and a mesophytic hardwood forest) were done on the flood-plain of Mountain Fork River, about 2 miles west of Eagletown, McCurtain County. All of the area trapped was said by local inhabitants to have been under water in the spring. Only one cotton-mouse (*Peromyscus gossypinus megacephalus*) and one cotton-rat (*Sigmodon hispidus texianus*) were taken in the thicket, and no mammals were obtained in the hardwood forest. Several mole tunnels and one pocket-gopher (*Geomys breviceps breviceps*) mound were seen. A swamp-rabbit (*Sylvilagus aquaticus aquaticus*) was the only other terrestrial mammal seen in the area. Two nights (500 trap nights) were spent in the hardwood forest on the flood-plain of Glover River at Glover, McCurtain County. The position of driftwood indicated that the flood-plain had been inundated. At this station, 8 cotton-mice were taken. This was a surprisingly large catch in view of the extreme scarcity of mice in the other flooded areas. A few mole tunnels were seen, and two moles were trapped. No other terrestrial mammals were seen.

The observations recorded above indicate that severe flooding in years of abnormally heavy rainfall affects adversely the populations of small, terrestrial mammals inhabiting flood-plains in eastern Oklahoma. In the case of some wholly terrestrial species that are confined to flood-plain associations such flooding probably produces virtual extermination of these species in some parts of their ranges. The fact that the mole was found, without exception, in all of the flooded areas probably indicates that this species was quite successful in escaping the flood-waters and that it reoccupied the flood-plain after the water had subsided.

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ACTIVITY OF BREWER'S MOLE (PARASCALOPS BREWERI)

By W. J. Hamilton, Jr.

Few attempts have been made to record the time of activity of our native mammals under natural conditions. The subject is an interesting one, and may be studied readily by any individual living where an abundance of any particular species exists. Moreover, little or no equipment is necessary, a little patience alone sufficing to produce valuable information.

Scheffer (1913) remarks that it is a common belief that moles of the genus *Scalopus* work only at periods recurring regularly each day; that in the morning, at noon and again in the evening the animals are impelled by hunger to extend their surface runways in search of food. His own observations, conducted in Kansas, tend to show that in the fall at least, there is no stated time of day when the animal is more or less active than at any other. Scheffer made breaches in mole burrows and observed that 135 were repaired at night while 116 were repaired in the daytime. Hourly observation during the day showed that this mole is not a creature of the periodical feeding habits commonly ascribed to it; moreover its daily activities can not be classed as diurnal, nocturnal, or crepuscular.

Observations by Arlton (1936) on the prairie mole, *Scalopus aquaticus machrinus*, led him to believe that this species is more active during the day than at night. Some moles seem to be most active in the early morning hours, while others work later. There appeared to be one period of activity extending from 8 a.m. to 2 p.m. One hundred and twenty-six records of mole activity suggested that more activity occurs in the afternoon than in the morning. I have recorded elsewhere (Hamilton, 1931) some scanty data on activity of the star-nosed mole (*Condylura*) which suggests that the animal is much more active by day than by night.

The observations detailed below were made on the Edmund Niles Huyck Preserve at Rensselaerville, Albany County, New York, during the summers of 1937 and 1938. Small mammals of several species were unusually abundant during those periods. I took the opportunity to study particularly the small mammal fauna while conducting a general biological survey of the preserve. The abundance of moles made these animals a particularly worthy subject for study.

Simple field methods were used to obtain data on mole activities. Tunnel locations were marked by pushing a trimmed branch into the ground three or four inches south of the part to be marked. A 5 x 7 inch white card was fastened to these stakes with thumb tacks. These cards facilitated observation during the night, when a large flashlight was employed to locate and observe the marked burrows The card likewise proved efficient in marking the site during the daytime, for wild sarsparilla, cohosh, ferns and other dense growth often hid the stake very effectively.

Surface burrows were marked by pressing in two inches or so of the tunnel roof. Small sections of the deeper tunnels were occluded by packing an inch or two of the passage with dirt. If a mole tunnel is being used regularly any obstruction is soon removed by the animal. Thus records of the approxi-

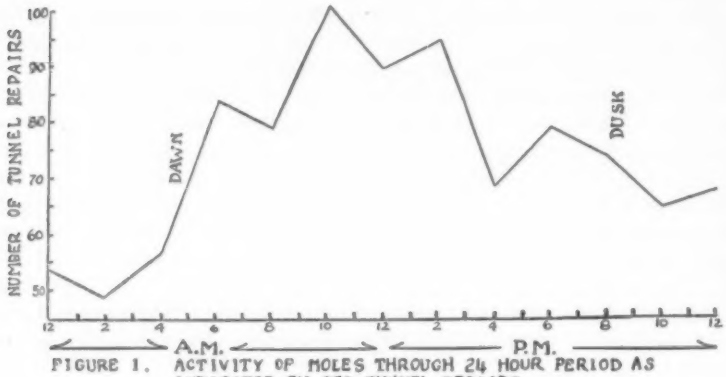

FIGURE 1. ACTIVITY OF MOLES THROUGH 24 HOUR PERIOD AS INDICATED BY 973 TUNNEL REPAIRS.

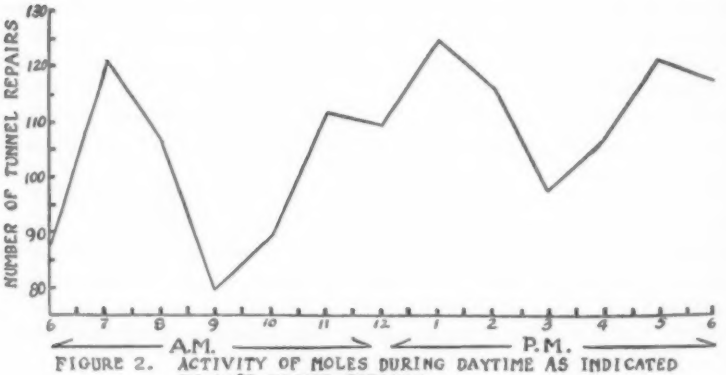

FIGURE 2. ACTIVITY OF MOLES DURING DAYTIME AS INDICATED BY 1383 TUNNEL REPAIRS.

mate time of repair, if sufficiently numerous, should provide significant data on the period of activity.

To determine whether *Parascalops* was more active by day or night, marked tunnels were visited every two hours for three alternate nights during late July, 1937. Similar visits were made to these tunnels in the day during this period. In all, 131 burrows were visited a total of 4716 times. Repairs were

noted 973 times. Figure 1 suggests that this animal is more active during the day than at night. Arlton (1936) observed *Scalopus* similarly to be less active at night. He attributes this to the action of earthworms, which leave the soil for the surface after dark, thus apparently creating a nocturnal food shortage for the mole and a consequent diminution in the animal's activity at night. However, *Parascalops* apparently leaves its burrow at night and forages for food in the forest litter, for several were caught weekly by a cat which roamed the woods under observation. The recorded activity of the mole may thus be faulty for the hours of darkness, because the animal's customary absence from its tunnel during the night may result in lessening the number of repairs made at this period.

During late June to mid-August, 1937 and late August of 1938, 147 burrows were marked and the tunnels disturbed. The burrows were visited from 6 a.m. to 6 p.m. at hourly intervals, a total of 10,185 observations being made. The burrows were repaired several thousand times, but only 1383 records of the time at which such repairing was done are available. Figure 2 indicates the approximate time at which the burrows were repaired. Observations were recorded to the nearest hour.

Most of the mole tunnels were found in damp maple-beech-hemlock woods, with a rich cover of ferns and other low-growing ground plants. There were numerous man-made trails through the woods, and mole tunnels crossed these, often little more than a few paces apart. The population of *Parascalops* was unusually high in this area during the summer of 1937 and 1938, trapping records and sign suggesting ten or twelve animals to the acre.

Although other small mammals (*Blarina*, *Peromyscus*, *Sorex fumeus*, *Synaptomys* and *Napaeozapus*) used the mole tunnels as highways, these smaller animals never remodelled the burrows when such were disturbed. In brief, there was no evidence that repairing of the damaged burrows was done by any animal other than moles.

The records suggest that *Parascalops* exhibits no rhythmic activity such as is evident in *Microtus* (Hamilton, 1937) and *Peromyscus* (Johnson, 1926). This mole appears to be up and about at all hours, but it is apparently more active by day than by night. Probably predation is greatest at night, when the moles leave their burrows to capture the small nocturnal creatures which swarm on the forest floor as darkness falls.

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NOTES ON EARLY WINTER FOOD HABITS OF THE BLACK BEAR IN GEORGE WASHINGTON NATIONAL FOREST

BY CLARENCE COTTAM, A. L. NELSON, and TALBOTT E. CLARKE

The black bear has, surprisingly, survived the white-tailed deer in several mountainous sections of Virginia. In some areas from which the deer have been gone for 30 years or more, the black bear is still present and is hunted as a game animal. Two years ago in one county alone it was reported that 60 bears were taken by hunters in a season of a month and a half. Many factors have probably been operating in favor of the survival of bears in the Virginia mountains, but perhaps the most important are: (1) Inaccessibility of large tracts of bear range; (2) interest in bear hunting not developing until deer were on the decline; and (3) the insignificant amount of grazing. Because of the last-mentioned factor there is no conflict of any consequence between bears and cattle and sheep, and as a result the persecution of bears by stockmen has been held to the minimum.

Other than in the Dismal Swamp, much of the good bear territory in Virginia is now within the boundaries of the George Washington National Forest, which comprises approximately 1,400,000 acres of ridge country in Virginia and West Virginia. Adequate bear range is available and there is therefore no reason why the black bear cannot be perpetuated indefinitely in this region.

With the George Washington Forest the key to the bear situation in Virginia, some brief comments on prevailing conditions in that area would seem to be appropriate.

Approximately 91 percent of the George Washington National Forest has been cut over during the past 100 years. The present composition may be divided according to age classes as follows: Open land, 0.5 percent; 0 to 20 years, 26 percent; 21 to 40 years, 49 percent; 41 to 80 years, 12 percent; 81 to 120 years, 3.5 percent; and 121 years or older, 9 percent. The forest type is commonly known as Appalachian hardwood, and the stand consists largely of deciduous species with occasional patches of conifers.

The elevation of the ridges is from 1,500 to 4,500 feet. In some places there is little or no subsoil, the surface soil directly overlying the bedrock. In some sections the slopes are covered with boulders or rock slides, and in others with numerous rock outcroppings or ledges.

The drier sites on the ridges are covered for the most part with bear oak and associated species, including scarlet, black, red, and chestnut oaks; pitch, shortleaf, and table-mountain pines; common locust; and chinquapin. The dry slopes and flat ridges support mixed stands of hardwoods, composed chiefly of black, scarlet, and chestnut oaks, shagbark and mockernut hickories, tupelo, and common locust. In the deep fertile soils, as found in coves on north slopes, grow mixed stands of northern hardwoods, typical species being sugar maple, red maple, yellow birch, red and white oaks, basswood, black cherry, hemlock, and white pine.

This background should, of course, be taken into consideration when studying the food habits of the bears and when developing bear-management practices.

Through the facilities of the United States Forest Service it has been possible during the past four hunting seasons, 1935, 1936, 1937, and 1938 to obtain from hunters a small series of bear stomachs taken on this forest. Few data have been recorded on bear foods, and therefore this material, even though limited, is especially valuable.

Bear hunters are usually associated in groups, and from leading members of such groups it was possible to obtain 25 bear stomachs taken during the hunting seasons of 1935 to 1938. Practically all were from bears shot in November, only four being from animals taken in December. All stomachs were from animals that had been driven into gun range by trained bear-hunting dogs. Weights of two of the animals are available: one, a male, weighed 325 pounds, and the other, a female, 225 pounds.

Many of the animals had probably been chased for a considerable time before being taken, and the stomachs of most of them were only partly filled. A few, however, appeared gorged or well filled, the contents of one measuring 730 cc., and another 544 cc.

In the following tables are listed the major and miscellaneous foods recorded in the examinations; seven stomachs were almost empty and four others contained only small quantities of food; consequently, these were not figured in percentage computations.

It is obvious that during November the black bear on the George Washington National Forest is largely vegetarian. All of the more abundantly represented food species are common on the forest and more or less widely distributed. The oaks are the dominant tree growth and apparently contribute an abundance of food to the bear diet. The tupelo is a common tree and obviously furnishes an abundance of food for bears. One stomach, in fact, contained 640 tupelo fruits. The deerberry (*Vaccinium stamineum*), a heavy fruiter, is a common species and apparently is a valuable source of fall food. The extent to which bears feed on the fruits of this species is indicated by the fact that one animal had taken more than 800 of the fruits in a single meal. The fruits of grape, greenbrier, chokeberry, and mountain

winterberry are all available to bears in the fall and obviously the animals make much use of them.

Of the ten most important items, which aggregated 95.89 percent, seven of these, or 89.53 percent, consisted of fruit. *Lobelia* and buttercup (2.86 percent) were represented by foliage, while animal matter, consisting entirely of rabbit, entered into the diet of two of the bears and supplied 3.50 percent of the total. It is not known whether the rabbits represented kills or carrion. The stomach containing *Lobelia* was not well filled, and whether this is to be considered evidence of grazing is problematical, although judging from the variety of vegetation found in the stomachs, it seems not unlikely that green

TABLE 1.—*Principal food items recorded in examination of the stomach contents of 14 black bears collected on the George Washington National Forest, during Nov.–Dec., 1935–1938*

FOOD	NUMBER OF STOMACHS IN WHICH FOUND	PERCENTAGES OF TOTAL FOOD
Vegetable		
Oaks (*Quercus* spp., including *Q. ilicifolia*, *Q. rubra*, and *Q.* (*borealis?*))	10	51.99
Blueberry (*Vaccinium* spp., chiefly *V. stamineum*)	5	17.44
Tupelo (*Nyssa sylvatica*)	2	6.57
Grape (*Vitis* sp.)	3	5.14
Chokeberry (*Aronia melanocarpa*)	2	4.75
Greenbrier (*Smilax* spp., including *S. glauca*)	2	2.57
Lobelia (*Lobelia* sp.)	1	1.79
Mountain winterberry and holly (*Ilex monticola* and *I. opaca*)	2	1.07
Buttercup (*Ranunculaceae*)	1	1.07
Animal		
Cottontail rabbit (*Sylvilagus floridanus*)	2	3.50

material, even though usually present only in small quantities, is intentionally taken during the November–December period.

Because the crop of mast is not uniformly good from year to year, the bears must of necessity vary their diet. Seven bears taken in November of 1935 and 1936 had made acorns 82.7 percent of their last meal, whereas 5 shot during the 1937 hunting season, when the mast crop on the George Washington National Forest was generally a failure, had consumed acorns only to the extent of 0.6 percent of the average meal. Acorn fragments and oak leaves comprised 3 percent of one meal and only a trace of a second. In contrast to this, 6 of the 7 bears taken during the 1935–36 season had made acorns from 89 to 100 percent of their meals. Of the two filled stomachs taken late in December 1938, a year when there was a bumper mast crop, this easily obtained food supplied 72.50 percent of the two meals.

TABLE 2.—*Miscellaneous food items recorded in examination of 25 black bear stomachs collected on the George Washington National Forest, during Nov.–Dec., 1935–1938*

Each item listed made up less than 1 percent of the bulk food

FOOD	NUMBER OF STOMACHS IN WHICH FOUND
Animal	
Undetermined birds	3
Insects and related arthropods	6
Mice (including 1 microtine)	2
Squirrel	2
Vegetable	
Mountain-laurel (*Kalmia latifolia*), fruiting capsules and leaves	4
Wintergreen (*Gaultheria procumbens*), leaves and fruits	4
Aster (*Aster* sp.), leaves and seeds	3
Composites (Compositae), leaves and seeds	3
Undetermined heaths (Ericaceae), leaves and seeds	3
Canada hemlock (*Tsuga canadensis*), needles	3
Pine (*Pinus* spp.), needles	4
Redcedar (*Juniperus virginiana*), leaves	2
Goldenrod (*Solidago* sp.), seeds	3
Hickory (*Hicoria* sp.), fruits	2
Menziesia (*Menziesia pilosa*), fruiting capsules	2
Alder (*Alnus* sp.), seeds	1
Yellow birch (*Betula lutea*), seeds	1
Blackberry (*Rubus* sp.), seeds	1
Bromegrass (*Bromus* sp.), seeds	1
Broomsedge (*Andropogon* sp.), leaves	1
Dandelion (*Taraxacum* sp.), seeds	1
Dogwood (*Cornus* sp.), buds	1
Nimblewill (*Muhlenbergia schreberi*), seeds	1
Bracken (*Pteridium aquilinum*), leaves	1
Hawthorn (*Crataegus* sp.), seeds	1
Hawkweed (*Hieracium* sp.), seeds	1
Hogpeanut (*Falcata comosa*), seed pods	1
Common locust (*Robinia pseudoacacia*), seeds	1
Bluegrass (*Poa* sp.), seeds	1
Meadow-parsnip (*Thaspium barbinode*), leaves	1
Rosemary (*Andromeda* sp.), leaves	1
Rose (*Rosa* sp.), seeds	1
Sedge (*Carex* sp.), leaves	1
Shadbush (*Amelanchier canadensis*)	1
Wild sarsaparilla (*Aralia nudicaulis*), seeds	1
Sweetfern (*Myrica asplenifolia*), buds	1
Eupatorium (*Eupatorium* sp.), achenes	1
Undetermined material, chiefly leaves	11

During the 1937 season, when the mast crop was largely a failure, a marked increase was noted in the consumption of *Vaccinium*, grape, greenbrier, tupelo, and other wild fruits.

The ruffed grouse on the forest during November and December, 1937, were forced off of their acorn diet also, only a trace of this item being found in the crop and gizzard contents of 52 birds collected during that period. In 1936, as a contrast, acorns composed more than 31 percent of the food of 51 of these birds. Although not eaten as extensively in 1935, acorns made up 2.75 percent of the food of 134 birds collected during that year.

The black bear is much more of a clean feeder than might be expected. It takes a very small quantity of twig material while feeding on such small fruits as tupelo, deerberry, mountain holly, chokeberry, and grape. In eating grapes, however, whole bunches are taken in single bites. The small fruits, at least, are apparently largely bolted. There is no evidence to show that any great amount of chewing is done, as the seeds of most of the fruits contained in the stomachs examined were entire.

In closing, it may be of interest to comment briefly on the anatomy of a bear stomach, as it is not like the stomach of a typical carnivore. The most outstanding anatomical feature is the more or less distinct separation of the fundic and the pyloric regions. There is an obvious constriction that separates these parts of the stomach, and it seems that each part functions more or less independently. In one stomach it was especially interesting to note how the food, consisting of fruits of tupelo, mountain-holly, and grape, was almost completely de-pulped in the pyloric region, whereas in the cardiac region the same fruits were still largely intact. There are obvious gross differences in the glandular structure of the two regions, although no study was made of them.

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MATERNAL BEHAVIOR OF THE POUCHLESS MARSUPIAL MARMOSA CINEREA

By Frank A. Beach

The opossums here described were brought to the Laboratory of Experimental Biology at the American Museum of Natural History during the second week in January, 1939. We are indebted to Mr. L. Brodie of the Fruit Dispatch Company for the specimens, and to Mr. G. H. H. Tate for identifying the species. The animals were taken from a shipment of bananas from Ecuador. There are numerous records of small opossums arriving in this country via banana boats, but nearly all such come from Central America or Puerto Rico and are either *Marmosa isthmica* or *Marmosa zeledoni* (Adams, 1928; Anthony, 1928; Hudson, 1932; Kraatz, 1930; Potter, 1930; Wagner, 1928; Warren, 1928).

The female *M. cinerea* weighed 51 grams and measured 120 mm. head and body length and 170 mm. tail length. The coat of very fine hair was medium brown dorsally and laterally, and shaded into a very light brown ventrally. The hair around the eyes was very dark brown. The eyes were jet black and exophthalmia was marked. The pinnae were large and very thin and the pinnae reflex was marked.

The female showed no evidence of conditioning to handling during the two months that she survived. From the time of her arrival at the laboratory the opossum was extremely wild and aggressive. The defense pattern of *Marmosa* has been described by Enders (1935) and although his description refers to *M. isthmica* and *M. zeledoni* it is equally applicable to *M. cinerea*. Figure 1 illustrates a typical defense pose frequently assumed by the female. This posture could be elicited in the female by opening the cage or by making a loud noise near the cage. Frequently, when on the defensive, the female uttered a sharp hissing noise. Kraatz (1930) mentions the voice of *M. zeledoni* as consisting of a low chirp.

Figure 3 shows the lactating female's walking posture and the manner in which the animal's hind quarters are held well off the ground. The maintenance of this posture prevents scraping the young against the floor of the cage. When the young were removed from the female, or, later, when they released themselves, the female walked holding her body approximately parallel to the floor.

When the female was brought to the laboratory there were five young attached to her mammae. Tate (1933) mentions the fusion of tissue which is reported to occur between the lips of the young and the teat of the lactating female. Enders (1935) regards the occurrence of such fusion as highly problematical. It is possible to state with assurance that there was no fusion between the lips of the young and teats of the female that we studied. To be sure, the young opossum's grasp on its mother's nipple was remarkably

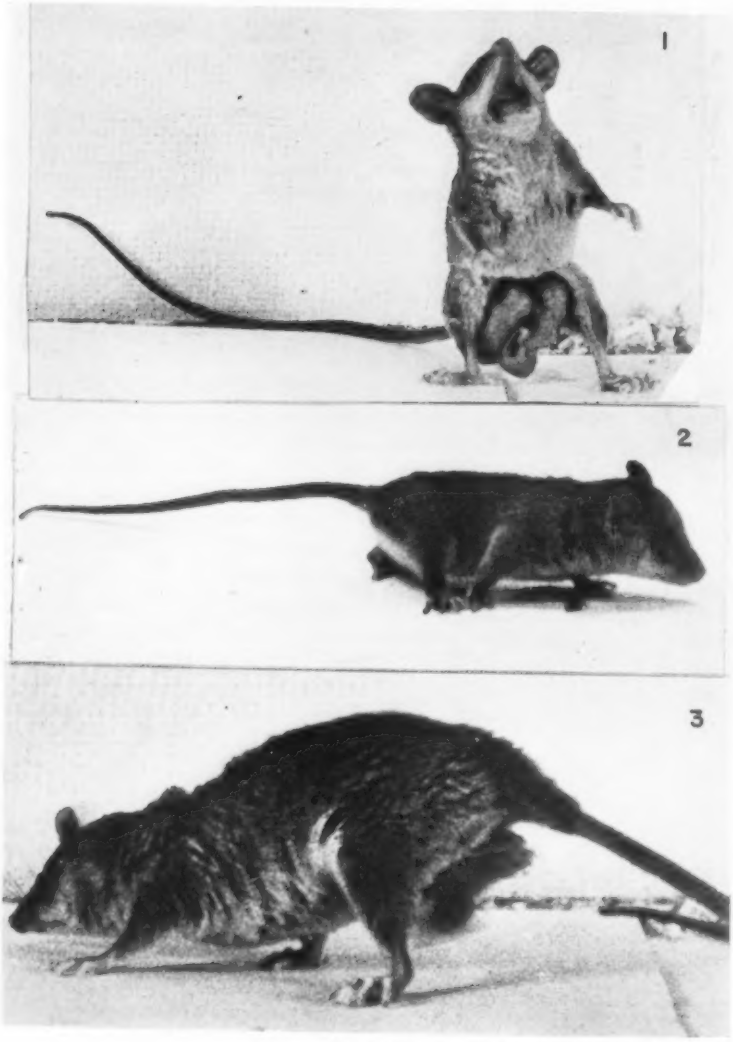

PLATE 1

Fig. 1.—Female *Marmosa cinerea* with young—standing defense posture.
Fig. 2.—Juvenile *Marmosa cinerea*, April 6, 1939.
Fig. 3.—Lactating female, walking posture.

strong. If a young *Marmosa* was picked up with forceps the female frequently dangled in mid-air, supported entirely by the baby's sucking hold. Nevertheless it was possible to separate female and young; and when this was accomplished there was no evidence that any actual fusion had existed. Furthermore the young *Marmosa* quickly regained its hold on the mamma and the strength of grip was as great as before the forcible separation. These observations do not preclude the possibility that there is fusion very early after the birth of the young. The answer to this question must await observations upon young *Marmosa* of known age.

When first observed, the young were approximately 23 mm. in length—smaller than a new born rat (*Rattus norvegicus*). Enders (1935) wrote that the smallest young *Marmosa* he had observed was approximately 22 mm. in body length, a size comparable to that of our specimens. However, the young described by him were fully covered with hair. It seems probable that the animals herein described were younger than Enders' specimens, which may have been *M. isthmica* or *M. zeledoni*. The young opossums, when we first observed them on January 10, 1939, were hairless, blind, and apparently deaf. Although they were smaller than newborn rats the young opossums exhibited a higher state of physical development. The baby *Marmosa* possessed well-developed grasping and clinging reflexes of the feet. A baby opossum in an inverted position clung to a piece of cotton for 30 minutes and showed no signs of fatigue. The *Marmosa* young cling to their pouchless mother throughout the first part of their lives by means of foot- and mouth-grasping reflexes. Figure 1 shows the young attached to the female's mammae. Enders (1930) describes similar clinging observed in Central America. Potter (1930) observed it, and Hudson (1932) found 6 living young *Marmosa* attached to a dead female.

When separated from their mother the young that we studied emitted a rapid series of high-pitched squeaks. In some cases this vocalization persisted almost without interruption for half an hour, until the young were returned to the female.

Eleven days after their acquisition the young *Marmosa* measured 40 mm. in body length. Short, fine hair covered the body. The eyes were still closed. Body movement in response to a loud noise was taken as evidence of some auditory sensitivity. Thirteen days later the body hair was much longer but the eyes were not yet open. Body length had increased to 62 mm. At this stage of development the young *Marmosa* were frequently detached from the mother. They did not venture out of the small nest box, but the female was observed moving about the outer cage while the young remained inside.

The eyes of the young opossums opened about February 10, one month after our observations began. With the development of visual sensitivity the behavior of the young changed noticeably. They began to feed inde-

pendently and to partake of the mother's diet of meal worms and fruit. At the same time they began to move freely about in the large cage. It was interesting to note that at the observer's approach the young retreated hurriedly to the living box, or, if they were far from the living box and the mother was nearby, the young frequently ran to her and grasped the hair of her coat to climb on her back or under her belly. This response is of especial interest because the young were, so far as we were able to determine, completely weaned. Before weaning, a young *Marmosa* re-attached itself to the adult female and immediately began searching movements of the head and foreparts, movements which persisted until the mouth was fixed to a nipple. After weaning, when a baby ran to the mother, we observed no attempt to grasp a nipple with the mouth. Enders (1935) described similar behavior exhibited by partly-grown *Marmosa* taken in the field.

One striking modification of the young opossum's behavior attendant upon the opening of the eyes was the adoption of the defense reactions which characterized the adult female. When cornered, the babies responded to the approach of the observer's hand exactly as the mother responded. The mouth was held wide open and one forepaw was raised in a position ready-to-strike. The pugnacious behavior of young *Marmosa* has been noted by Enders (1930).

Three months after our observations began, the surviving young behaved like the female. They had not become tame and they reacted to every disturbing stimulus with the immediate assumption of the defense pattern described.

One of the young opossums died a few days after we acquired the animals. A second died during the maternal tests to be described below; and a third died 10 days later. At the present time the two surviving young appear to be in good health. The only foods they will eat are meal worms and tropical fruit.

TESTS OF MATERNAL BEHAVIOR

While the female *Marmosa* was in good health we were able to conduct a series of experiments designed to test for maternal reactions.

Nest building.—The female with her young was placed in a large observation cage 3 feet square and 1 foot deep. In one corner of the observation cage was a nest box 6 inches cube. Strips of paper towelling were scattered about the observation cage. The female gathered all available paper and carried it into the nest box. No elaborate nest was built but the paper was used to line the floor of the box. The female carried paper strips in her tail or in her mouth. Tate (1933) reports that there are few nests recorded for *Marmosa*. He states that this opossum frequently inhabits disused birds' nests and may on occasion construct its own nest from suitable material.

He cites the observations of Alfaro (1897) to the effect that *M. "cinerea"* (=*alstoni*) nests in the branches of trees. Enders (1935) found *Marmosa* furnishing nesting boxes with dry leaves. He adds that abandoned birds' nests are used by the opossums, and that the animals sometimes fashion nests from strips of banana leaves.

Retrieving.—Kraatz (1930) describes briefly the behavior whereby the female *M. zeledoni* assists a detached young in reattaching itself to the mammae. His observations agree closely with our own. Potter (1930) reports a behavior pattern which we did not observe in *M. cinerea*. He saw a female *Marmosa* (species unidentified) toss her young in the air with her snout. The young thus catapulted through space alighted on the mother's back and clung to her fur.

Three retrieving tests were conducted in the course of the present experiments. In these tests the young were detached from the female and scattered about the observation cage. The young were handled with forceps to avoid contamination with human body odor. The female was replaced in the observation cage and a stop clock was started. Observations on her behavior were dictated in a low voice to an assistant. Although the female was obviously excited by being handled during preparations for the tests she lost no time after her return to the cage, but immediately began gathering her scattered young.

In previous communications (Beach 1937, 1938, 1939) we have described the retrieving behavior of the parturient rat (*Rattus norvegicus*). The retrieving behavior of the *Marmosa cinerea* presents several interesting contrasts to the maternal reactions of the rat. Both animals approach their young and nose it gently. After this brief bit of exploratory behavior the rat grasps the baby in her mouth and carries it to the nest, there to deposit it and return for a second young animal. After the *Marmosa* noses her detached young she pushes it backward under her belly with snout and forepaws. A young *Marmosa* treated in this fashion immediately rolls over on its back and siezes the ventral hair of the mother with all four feet. As soon as a grasp is obtained the young opossum moves rapidly forward, shifting the hold of the right and left feet alternately. As it progresses over the mother's belly the young one holds its snout close to the skin of the mother and repeatedly moves its shoulders, neck, and head back and forth. These searching movements continue until the mouth fastens to a nipple.

During the first retrieving test the female *Marmosa* was presented with four of her own young. In 11 minutes she had discovered all of the young and they were attached to her body. In the second and third tests, conducted on successive days, two newborn rats were included with the young opossums. The reactions of the female opossum to the young rats are best described by quoting directly from experimental records. The following notes are taken

verbatim from observations dictated by the writer while the experiment was in progress.

Time	*Notes*
7 seconds	Finds first opossum. Retrieves it.
20 "	Finds first rat. Investigates. Pushes the rat under her.
30 "	Finds second opossum. Pushes it under her immediately. Both opossums cling to mother.
45 "	Investigates rat again and pushes it under her.
5 minutes	Female still trying to get rat to take hold. Pushes it under her like her own young.
7 "	Licks young rat.
11 "	Pushes rat under her.
15 "	Female is driven away from rat by experimenter.
18 min. 4 sec.	Female returns to first rat. Pushes it under her twice, and hovers over it.
21 minutes	Female is driven away from first rat.
22 "	Finds second rat.
22 min. 5 sec.	Finds third opossum and retrieves it.
22 " 35 "	Attempts to retrieve second rat. Pushes it under her like her own young.
23 minutes	Third opossum drops twice and is retrieved immediately each time.
25 "	Retrieves opossum which dropped off. Investigates young opossum just as she investigated first rat 45 seconds after test began.
25 min. 25 sec.	Pushes young rat under her.
25 " 35 "	Retrieves opossum which dropped off.
25 " 45 "	Pushes rat under her.
26 minutes	Pushes rat under her.
28 "	Climbs on screen covering the cage. Three opossums clinging to her.
30 "	One opossum drops.
34 "	Female driven off the screen.
34 min. 5 sec.	Finds opossum that dropped and retrieves it.
34 " 10 "	Pushes rat under her.
35 minutes	Pushes rat under her. At this point she has ceased to investigate rat; merely attempts to retrieve it.
36 "	Fourth young opossum pushed over to the mother by experimenter. At the same time a rat is pushed to her. Immediately she pushes the opossum under her.
36 min. 15 sec.	Pushes both rats under her. Four opossums are clinging to the mother.
37 minutes	Pushes rats under her.
1 hour	Still trying to retrieve rats.
24 hours	Female is in the living box with 3 young opossums and one rat. The fourth baby opossum and the second rat are lying approximately three feet away from the living box. The opossum is dead, but the rat is alive and unharmed.

A retrieving test identical with the one described above was conducted on the following day with comparable results. The female again tried to retrieve the young rats. One of the rats was found unharmed in the living box on the following morning. The rats used in these tests were too young to

have crawled to the nest box, and they could not have gotten over the 1-inch sill in the door even if they had moved by themselves.

It may be of some significance to note that the female showed no tendency to grasp either her own young or the rats in her mouth or with her prehensile tail. That she was capable of such behavior is shown by the fact that she frequently carried nest-building material in her mouth or with her tail. The stimulus of a detached young seemed to elicit a single, unvarying response, namely, pushing the young under her belly. When this response did not result in the young rat's attaching itself to her, the adult gave no evidence of changing her mode of response. The transfer of two young rats across three feet of floor space and into the nest may have been accomplished by carrying the rats in the mouth or tail, or the rats may have siezed nipples with their mouths and thus been dragged across the cage. This frequently happens when a lactating rat leaves her nest.

Five weeks after her arrival at the laboratory the female opossum was found dead in her cage. The cause of her death is unknown. The diet which we were able to provide seemed to keep her weight well up to standard and she showed no evidence of poor health on the day before her death. When found, she lay in her drinking dish. It seems unlikely that she could have drowned in three inches of water, from which she could easily have escaped.

SUMMARY

Experiments upon a lactating female opossum, *Marmosa cinerea* have revealed that this animal exhibits maternal reactions comparable to those of the parturient rat, *Rattus norvegicus*. The opossum gathers available material to build a nest and retrieves her scattered young. The retrieving activity of the *Marmosa* differs from that of the rat in that the former does not carry her young in the mouth, but pushes them under her belly where they can seize the ventral hair and cling to the mammae. The opossum's reactions to the newborn rats were indistinguishable from her responses to her own young. The rats, however, failed to seize the female's coat and consequently were not retrieved. Young rats left in the experimental cage over night were found in the *Marmosa's* nest box the following morning.

The development of the young *M. cinerea* has been briefly described, and the appearance of certain behavior patterns has been subjected to comment.

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NOTES ON ESCAPE BEHAVIOR IN THE FLORIDA MARSH RABBIT

BY A. F. CARR, JR.

For the past four months I have kept a pair of hounds on the grounds of the University of Florida Biology Station at Lake Newnan, Alachua County, Florida. The station lies in a fine mesophytic hammock, bounded on the north and west by a creek-swamp, on the south by a paved road, and on the east by the lake shore. Dr. Frank Blair's study of the marsh rabbit (Jour. Mamm., vol. 17, pp. 197–207, August, 1936) was based in large part on observations made in this hammock.

The dogs have run at large for parts of perhaps 60 days or nights during the past fall and winter, most of this time having been spent in pursuit of one or another of the rabbits occupying the hammock. I have thus had occasion to hear or witness some two hundred rabbit-races involving a limited number of individuals in a restricted area, and to observe certain traits of behavior which seem to be of interest.

The rabbit population of the hammock consists almost entirely of marsh rabbits (*Sylvilagus palustris paludicola*). This species is not of much interest to hunters, chiefly, perhaps, because of the relative inaccessability of its favorite habitats; also its meat is considered inferior to that of the cottontail; and it usually suffers a more extensive infestation of warbles. Thus its behavior in front of hounds has been observed less frequently than that of more popular game animals.

Blair expressed the opinion that the marsh rabbit is chiefly nocturnal; this is substantiated by my observations. In the daytime the rabbits are almost always jumped from forms in scattered brush in the high, open woods. At night they are jumped usually after a more or less protracted period of trailing, indicating a leisurely foraging before the arrival of the dogs. I have watched a dog on leash follow these trails late at night, presumably after foraging has continued for several hours. The wanderings of the rabbits thus traced seemed to be aimless, erratic, and extensive; but they rarely exceeded 200 yards in point-to-point distance covered.

Despite its short legs and awkward gait, the marsh rabbit is very efficient in eluding a pursuer. Of the large number which the dogs have jumped, only one, to my knowledge, has been caught on the ground, and this a young, emaciated, warble-infested individual that was routed in an area devoid of cover. By determining from the cry of the hounds the general direction in which the rabbit is running it is often possible to take a stand in an open place in the line of the quarry's retreat and to observe its activities in flight. This is best accomplished at night, with the aid of a headlight, the beams of which have little apparent effect on the rabbits. Those which I have watched in this way have all seemed surprisingly unhurried and self-possessed, showing no sign of panic, even with the dogs in full cry a hundred yards behind. The pace is a short hop with numerous short pauses and changes of direction. Two rabbits which I watched back-tracked for some yards and then jumped to the side to continue in the original direction. The hounds continually over-run the trail thus laid, and have to resort to foot-scent in working out its intricacies.

Often an individual will stop abruptly in front of the dogs, hop under a small bush or into a clump of grass, and "freeze," either in a form or on the bare ground. Strangely, although the scent must lead directly to the spot of concealment, the dogs are usually checked at the place for some time. In one instance I saw them work frantically for fully fifteen minutes before finally routing a rabbit which was all the while in plain view under a palmetto leaf.

If pressed closely for a long time, and routed from one temporary refuge after another, the rabbits usually end the chase by taking cover in a hollow log, a hollow tree, the burrow of a gopher-tortoise (*Gopherus polyphemus*), or among the tangled and interlocking roots of a clump of saw palmetto (*Serenoa repens*), or, less frequently, by taking to the swamp. Many of the rabbits which enter hollow trees climb some distance up the inside of the trunk. I found one twelve feet from the ground in the hollow of an ironwood (*Ostrya virginiana*) trunk, and I have seen several higher than my head. No rabbit has been seen to take refuge in the lake or to cross the paved road.

The single cottontail (*Sylvilagus floridanus mallurus*) which I have found frequenting the hammock is nearly always jumped in the same area—a strip

about 100 yards long and 50 yards wide, lying along the paved road. This rabbit (probably always the same individual) invariably crosses the road and runs directly to a patch of scrub on the other side, making a run of from 200 to 300 yards. This cottontail is probably only an occasional visitor in the hammock. The route taken by it in retreat is shown in the accompanying diagram.

In the diagram I have also indicated the courses adopted with some regularity by the marsh rabbits. Only those rabbits routed in the encircled

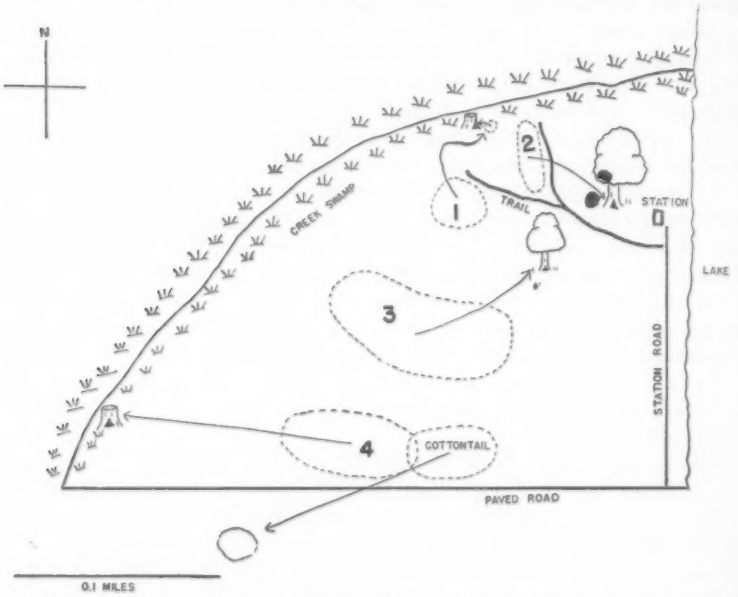

FIG. 1. Sketch map of the Lake Newnan hammock. Rabbits routed in the encircled areas frequently escape by the routes approximately indicated by the arrows. There is apparently nothing predictable about the behavior of rabbits encountered in the intervening areas.

areas show any definite or predictable routes of flight. Even here the routes are by no means invariable, but they have been taken so many times that their selection cannot be attributed to coincidence. These routes, and the cover to which they lead, are as follows:

1. Rabbit jumped in a holly (*Ilex opaca*) grove south of trail; runs northwest or north around head of trail, then northeast to palmetto patch; usually eludes dogs here, but if routed runs north to swamp, swims one or more small pools, and enters one of several cypress stumps; a point distance of 200–250 yards. This course has been taken 7 times.

2. Rabbit jumped in a thicket between trail and swamp; runs southeast to enter hole in base of big magnolia tree (*Magnolia grandiflora*); a point distance of 100–150 yards. This route and cover have been used at least 5 times.

3. Rabbit jumped in an area at approximate center of hammock; runs northeast or north to hole in ironwood; a distance of 50–200 yards. This has occurred 4 times.

4. Rabbit jumped in burned-over area near road, midway between lake and creek; runs north, swims pool, and enters hollow stump of large cypress; a distance of 150–300 yards. This has occurred 5 times, but only at night.

It is my opinion that each of the four courses represents the behavior of one individual. All but route number 4 have been taken in the daytime as well as at night. On one night, when scenting conditions were unusually good, each of these four rabbits was put into its hole, the cottontail was chased across the road, and four other swamp rabbits (three of them half-grown) were jumped and eventually lost in the swamp. From these and other observations, it appears to me that the marsh rabbit population of the hammock probably consists of not more than 10 or 12 and not fewer than 6 or 7 individuals. This estimate agrees fairly well with that of Blair, based on trapping experience.

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THE SOLITARY LIVES OF TWO LITTLE POCKET MICE

By Vernon Bailey

The smallest known pocket mouse, *Perognathus pacificus*, was discovered in 1894 by Dr. Edgar A. Mearns, close to the place where the boundary line between Mexico and the United States runs into the Pacific Ocean. Five years later Frank Stephens collected one specimen near San Onofre. In 1931 Jack C. Von Bloeker, George G. Cantwell, Bernard Bailey, and Charles Schnack, a quartet of expert collectors, found them abundant on sandy bottoms near the coast of San Diego County, and supplied the museums with good series of specimens. They dug a few of the little animals alive out of their shallow burrows and gave two of them to me to bring home to Washington for further study.

The mice were named Bobbity, because half of his tail had been lost, and Bitty because she bit his tail, nose, and ears every time she got into his cage. Both were caught when full grown in August, 1931 and kept in comfortable, not to say luxurious, captivity as long as they lived, Bitty to December, 1935 and Bobbity to June 29, 1937.

During the summer of 1936 I joined Bernard Bailey and Charley Schnack in a more thorough study of these little animals among the sand dunes along

the shore near Oceanside, California, and gathered all possible information about their outdoor habits to go with the more intimate indoor studies.

Judging in part from the dozen or twenty specimens sometimes captured in a morning's round of our traps, and in part by the lines of tiny trails in the light sand and the numerous closed and well secreted burrows under the edges of creeping vegetation, the little pocket mice were abundant over their rather restricted habitat. None was discovered in the high hard clay soil back of the beaches.

The burrows, so far as examined, were generally simple and not extensive. Each burrow ended in a small cavity or nest chamber, without much nest, a foot or so below the surface. Like most food storers, these pocket mice apparently were solitary in their homes, a fact that probably explains why our pets would never live together, not for a peaceful moment. When placed in the same cage the fur began to fly at once and it was always Bobbity's fur. Though slightly larger, he never resisted Bitty's attacks. If she got into his nest box there was a terrible rumpus until he came bolting out of the door and took refuge in the roof of the cage, where he would hang puffing and wheezing, sometimes with a bloody nose or tail or paws, while Bitty either hunted for him around the cage floor or began carrying his store of seeds to some far corner and burying them in the sand. Never did she show a mark or scratch, nor would Bobbity offer the slightest resistance when attacked. He soon became so terrorized that we put him into a separate cage, which had to be kept at some distance from hers or he would not come out of his nest box. When a passageway was made between the two cages one night, Bitty drove Bobbity out of his nest box and carried away all of his store of seeds while he hung trembling to the wire mesh of his roof.

From the very first of their captivity they were perfectly gentle with us and either would sit in my hand and eat oatmeal or seeds or stuff their cheek pockets full of seeds and then try to find a place to hide them. They had no objection to being stroked and petted and if the air was chilly would snuggle down in my warm hand with evident enjoyment. Bitty was always busy, thrifty and eager for food to store, less quiet and affectionate than Bobbity; differences that were probably sexual and of importance in the home and family economy. Bobbity, however, also stored and worked hard to acquire all the seeds he could find and often filled his little nest box so full that he had to sleep outside. Whether he would have willingly shared any of this wealth with Bitty was never learned as she took by sheer force all she could reach.

Bobbity was timed in carrying and storing 3¼ teaspoonfuls of small mustard (or rape) seed, about 2,800 seeds, in an hour; but he handled larger seeds more rapidly.

The seeds were picked up in their tiny hands and put into the cheek pockets so rapidly that the motions could not be followed by our eyes and Bobbity

looked like a vacuum cleaner sweeping up dust over the floor as he moved slowly on his hind feet over the sand, using both hands in taking all the seeds as he went. With bulging cheeks he would then run to his nest box or a corner of the cage and with both hands empty his pockets in a neat little pile, approximately ⅛ of a teaspoonful at a time. If stored in the corner the seeds were well covered with sand, pushed over them with both hands and chin or thrown over them in a lively spray from both hind feet.

In the pockets of those collected for specimens were found the seeds of a little bean bush, *Lotus prostratus*, two species of salt bush, heliotrope, mustard, *Monanthochloe*, *Franseria*, a rush, and some rolled oats and wheat gathered from the trap bait. Von Bloeker recorded from their pockets, seeds of *Heterotheca grandiflora*, *Chrysothamnus*, *Centaurea melitensis*, *Croton californicus*, *Pluchea sericea*, and *Hordeum murinum*. These are, of course, but a small fraction of the number of plants drawn upon for food, but they indicate a general preference for the rich nutty seeds of the sunflower family, small bean seeds, and seeds of grass and sedges. In fact most available small seeds seem to be gathered for food, even the little hot mustard seeds.

In captivity mixed bird seed, hemp and sunflower seeds, rolled oats and chicken feed supplied most of their needs. The rich oily meats of sunflower seeds are apparently their favorite food but these were so large that only two seeds would go in one of Bobbity's pockets.

Water at times seemed a necessity and at other times was ignored for long periods. On their native soil in the frequent fogs, when all vegetation was nightly dripping with dew, water supply was no problem, but in captivity in dry heated rooms they drank a little water almost regularly. If without water for two or three days they became very thirsty and drank long and frequently. They drank from shallow dishes by putting the mouth on the surface of the water but whether lapping or sucking it up I could never tell. They liked best to suck or lick the water out of absorbent cotton. They always objected to a drop of water on their fur and would rub and roll frantically in the sand to get it off.

For a time both Bobbity and Bitty enjoyed exercising in their hollow wheels but generally they were so busy taking care of their seed stores that the wheels were not needed and their time was divided between working, eating, and sleeping.

While mainly nocturnal, and in their free state entirely so, they often came out of their nest boxes in the daytime to inspect their stores, look for new seeds, get a drink, or visit their toilet corner. Most of their little dry black pellets and an occasional drop of urine were deposited in a regular place, well away from the nest box.

They made fluffy cotton nests in the boxes and generally closed the doorway with cotton when they retired for a nap or for the day. Bobbity, however, would always come out of his nest if called and if the box were slightly

disturbed or the front of it scratched. It generally took him half a minute to wake up and make up his mind. Then he came slowly out; but he always came and would walk out of the little door hole into my hand, expecting something good to eat or a valuable contribution to his storehouse.

When Bitty died after about four years of captivity Bobbity showed no signs of missing her. He quietly died of old age, after about six years of captivity, when he was probably about seven years old.

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IDENTITY OF DASYPUS SEPTEMCINCTUS LINNAEUS WITH NOTES ON SOME RELATED SPECIES

By G. W. D. Hamlett

During the years 1936–38 I carried on a research program on South American mammals under a Fellowship from the John Simon Guggenheim Memorial Foundation. At present I am engaged in studying the armadillos, with the object of eventually revising the systematics of the family. Examination of specimens collected during the past two years in Brazil, and study of material in the museums of Brazil, Argentina, and Uruguay, has already enabled me to form some conclusions about the species of the genus *Dasypus*. In particular, I wish to settle here the status of the two species, *D. septemcinctus* Linnaeus and *D. hybridus* Desmarest, which two have been confounded for the past hundred years and more. Previous authors have treated the names as synonyms; recognition of the fact that two distinct species are involved enables us to clear away the confusion.

At present I am prepared to recognize five species of *Dasypus* from eastern South America; namely: *novemcinctus*, *septemcinctus*, *hybridus*, *kappleri*, and a fifth species which has been imperfectly described under the name of *D. "mazzai"* (see p. 335). It is likely that we shall eventually be able to designate several geographical races as valid subspecies under *novemcinctus*; but I am as yet unable to say how many of the numerous names in the literature actually stand for distinct local races, and how many are synonyms. Examination of the type specimens and of additional material from various localities will be necessary in most cases to decide finally the status of the names in question. There is no good evidence at present that the other four species named above possess local races sufficiently distinct to warrant naming them. One other species has sometimes been referred to this genus, *Dasypus* (or *Cryptophractus* ?) *pilosus*, the hairy armadillo of the Bolivian and Peruvian plateau. I have not examined specimens of this species and am not able to pass upon its generic position at this time; hence it is omitted from consideration in this paper.

The species dealt with here may be separated by the following key:

A. Usually five toes on the fore foot. Size large, weight 8 kilos or more.

1. *Dasypus kappleri*. Ears short, about 35% of head length. Tail about equal to body, 84 to 117% of body length, according to published descriptions. Carapace with 7–8 movable bands. Two or three rows of bony, projecting scutes on hind leg at knee. Teeth $\frac{8-9}{8}$. Amazonian and Caribbean regions.

AA. Four toes on the fore foot. Size smaller.

B. Movable bands 8–11, usually 8 or 9. Size medium, 3–5 kilos when adult.

2. *Dasypus novemcinctus*. Ears long, 40–50% of head. Tail long, equalling or exceeding body. Teeth usually $\frac{8}{8}$. Oklahoma to northern Argentina.

BB. Movable bands 6 or 7. Size small, less than 3 kilos when adult.

C. Ears and tail short.

3. *Dasypus hybridus*. Ears 25–33% of head. Tail short, 67–70% of body. Teeth usually $\frac{6}{8}$. Paraguay, Argentina, Uruguay, southern Brazil.

CC. Ears and tail of medium length.

4. *Dasypus septemcinctus*. Ears 40–50% of head. Tail 80–100% of body length. Teeth usually $\frac{6}{8}$. Brazil.

5. *Dasypus "mazzai."* Ears 40% of head. Tail medium, 80% of body. Teeth $\frac{8}{8-9}$. Cephalic shield without separate occipital lobe. Scales in middle thirds of scapular and pelvic shields equal sized, without the usual distinction between large and accessory scales. Salta, Argentina.

For the sake of brevity I am presenting the synonymies in a condensed form. I intend to publish them in full at a later date, when dealing with the entire family.

Genus **Dasypus** Linnaeus

1758. *Dasypus* Linnaeus, Systema Naturae, ed. 10, pp. 50–51. (Type by tautonymy, *Dasypus novemcinctus* Linnaeus)
1769. *Tatus* Fermin, Descr. gén. Colonie de Surinam, vol. 2, p. 110.
1775. *Tatu* Frisch, Das Natur-System vierfüss. Thiere, in Tabellen, 5, Tab. Gen.
1804. *Loricatus* Desmarest, Nouv. Dict. d'Hist. Nat., vol. 24, pt. 6, Tabl. Method. Mamm., p. 28.
1827. *Tatusia* F. Cuvier, in Lesson's Manuel Mammalogie, pp. 309–312.
1831. *Cachicamus* McMurtrie, Cuvier's Animal Kingdom, vol. 1, p. 163.
1835. *Cachicama* I. Geoffroy, Résumé Leçons Mammal., vol. 1, p. 53 (Emendation of *Cachicamus*.)
1854. *Praopus* Burmeister, Syst. Uebersicht Thiere Brasiliens, p. 295.
1874. *Mulctia* Gray, Proc. Zool. Soc. London, p. 246.

Dasypus septemcinctus Linnaeus

1749. *Erinaceus loricatus* L. Balk, Amoen. Acad., Stockholm and Leipzig, vol. 1, p. 281.
1758. *Dasypus septemcinctus* Linnaeus, Systema Naturae, ed. 10, p. 51.

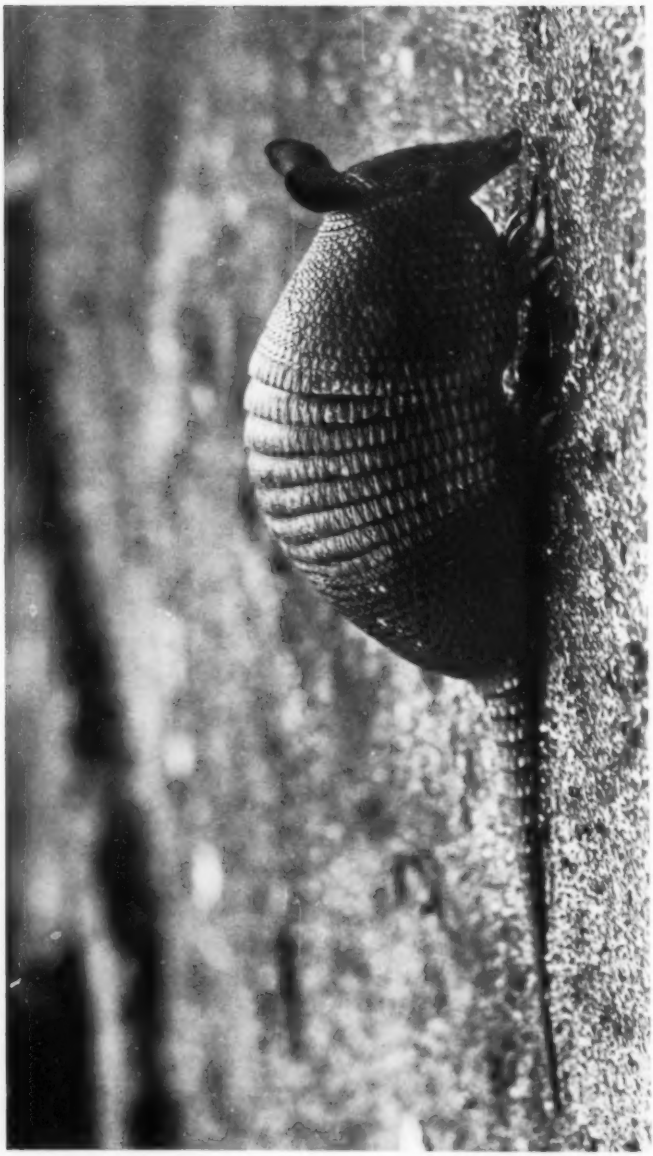

FIG. 1. *Dasypus septemcinctus* Linnaeus, adult male from Goyaz. Photograph taken at the Rockefeller Laboratory, Anapolis, Goyaz. Specimen now in the American Museum of Natural History.

1767. *Dasypus septemcinctus* Erxleben, Syst. Regni Anim., Cl. 1, Mammalia, p. 108. (Description more complete than that of Linnaeus.)
1775. *Dasypus septemcinctus* Schreber, Die Säugethiere, pt. 2, p. 220; Gmelin, 1789, Linnaeus Syst. Nat., ed. 13, p. 56.
1855. *Cachicama hybridus* Gervais, in Castelnau, Expédition dans les parties Centrales de l'Amerique du Sud, etc., Zoologie, vol. 2, p. 113.
1883. *Praopus hybridus* von Pelzeln, Zool.-bot. Gesell. Wien, Beiheft vol. 33, p. 99. (These two obviously refer to *septemcinctus*, because of the localities dealt with.)
1889. *Tatusia megalolepis* Cope, Amer. Nat., vol. 23, p. 134.
1894. *Praopus hybridus* von Ihering, Os mammiferos de S. Paulo, Catalogo, São Paulo, p. 17.
1895. *Tatusia* (*Muletia*) *propalatum* Rhoads, Proc. Acad. Nat. Sci. Philadelphia for 1894, p. 111.
1903. *Tatu megalolepis* Thomas, Proc. Zool. Soc. London, pt. 2, p. 243.
1904. *Tatusia hybrida* Goeldi and Hagmann, Bull. Museu Goeldii, vol. 4, p. 98.

Specimens examined. Museu Nacional, Rio de Janeiro, 7; Museu Ypiranga, São Paulo, 4; Museu Goeldii, Belém, 2; Rockefeller Laboratory, Anapolis, Goyaz, 1.

This is probably the smallest species of the genus. Measurements of a live animal from Goyaz, an adult male, were as follows: weight, 1800 grams; total length, 470 mm.; head, 67 mm.; tail, 200 mm.; ear, 35 mm.; hind foot, 60 mm. The accompanying photograph (fig. 1) does away with the necessity of attempting a detailed description. The species resembles *novemcinctus* quite closely except that the head is larger and the snout heavier, and the number of movable bands is less, six or seven in place of eight or more. Diagnostic characters are: the number of bands; the long ears (50 percent of the head in life, somewhat less in improperly dried skins); the tail almost equalling the body in length; the reduced number of scales in the carapace; and the $\frac{8}{8}$ tooth formula. I present, in the following table, a synopsis of some of these characters.

Linnaeus, in the Systema Naturae (ed. 10, p. 51), raised the question whether the number of movable bands was a sufficient basis for separating *septemcinctus* from *novemcinctus*. We can now answer this definitely in the affirmative. I have made a cursory examination of over 2000 individuals of *novemcinctus*, and have counted the bands carefully on several hundred of these, without finding fewer than eight full bands in any case. The usual number is eight full bands with a ninth incomplete (movable on sides only), or nine fully movable. Carapaces with only eight or with more than nine are less common; only rarely is the number greater than ten. On the other hand, several dozen carapaces of *septemcinctus* have shown six bands and an incomplete seventh, or seven bands, or seven and an incomplete eighth. I have never seen one with eight complete bands. The foregoing applies also to the thirty carapaces of *hybridus* seen by me, although Yepes has reported eight bands in an example of this species.

The Systema Naturae of 1758 refers to L. Balk's original description of the type of *septemcinctus* in the Amoenitates Academicae, based on a specimen which was in the University Museum of Upsala. This type specimen has disappeared, according to Lönnberg (Ark. f. Zool., 1928, 20A, no. 10), so that we have only the descriptions on which to base our identification of the species. Unfortunately, most of the characteristics enumerated are either of generic rank or are too indefinite to be of any diagnostic value. Balk does, however, note three characters which serve to identify the species: four toes on the front feet and seven movable bands in the carapace, while the tail is only slightly shorter than the body, "cauda . . . . corpore paullo brevior." The number of toes distinguishes Linnaeus's type from *kappleri*, the number of bands separates it from *novemcinctus*, while the length of tail clearly bars any identification of

it with the short-tailed *hybridus*. It is not possible to separate it from "*mazzai*" on the basis of the characters given in the Amoenitates Academicae, but the rarity and the restricted range of "*mazzai*" make it incredible that Linnaeus should have been dealing with a specimen of this latter species. The only plausible conclusion is that Balk's specimen and Linnaeus's type was the seven-banded Brazilian "tatú mirim."

Corroboratory evidence for the above conclusion may be derived from a consideration of the ranges of the other species described in the Systema Naturae (1758), and from those which were not included. Linnaeus's other armadillos are all primarily Brazilian; *tricinctus* and its synonym *quadricinctus* are strictly so, while the other three species barely overlap the extreme northern range of *hybridus*. On the other hand, Linnaeus was not acquainted with any of the common armadillos, *villosus*, *vellerosus*,

TABLE I

	HEAD MM.	EAR MM.	EAR / HEAD	BODY MM.	TAIL MM.	TAIL / BODY	NUMBER SCALES FOURTH BAND
D. septemcinctus							
Museu Nacional, Rio	52	28	.54	150	146	.97	50
" " "	60	28	.47	165	—	—	47
" " "	62	25	.40	175	145	.83	48
" " "	60	24	.40	185	157	.85	46
" " "	64	—	—	170	135	.79	52
" " "	71	—	—	183	173	.94	52
Museu Ypiranga, São Paulo	68	27	.40	190	—	—	48
" " " "	56	25	.45	129	125	.97	45
" " " "	73	28	.38	180	156	.87	52
" " " "	66	26	.39	158	138	.87	50
Museu Goeldii, Belém	70	28	.40	—	—	—	46
" " "	55	20	.36	147	—	—	45
Anapolis, Goyaz	67	35	.52	203	200	.97	—
D. septemcinctus, average	65	26.7	.43	178	153	.89	48.4
D. hybridus, average	75	23.3	.30	240	157	.65	54
D. novemcinctus, average	99	47	.47	268	295	1.12	60
D. kappleri (Museu Goeldii)	145	45	.33	500	420	.84	60
D. "mazzai" (paratype)	85	35	.41	255	210	.82	63

and *pichiy*, which are found in Argentina together with *hybridus* and "*mazzai*." All this indicates the probability that the type of *septemcinctus* came from Brazil, along with the other four species described in the Systema Naturae. I suspect, although my suspicion is probably not verifiable at this late date, that most of the armadillos in European collections in the time of Linnaeus came from the Dutch possessions along the Brazilian coast; Pernambuco, where Marcgrave's studies were carried on, being a likely point of origin. It is significant that not only are all of the Linnaean armadillos native to this northeastern region, but also that the two Brazilian species which were not mentioned in the Systema Naturae, *Dasypus kappleri* and *Priodontes maximus*, are absent from precisely this zone.

Erxleben, in the Systema Regni Animalis, followed Linnaeus through most of his description of the seven-banded armadillo, but he did make two significant additions to the original account. He gave definite measurements, body ten inches and tail

nine inches; and he places the habitat correctly "in Brasilia" instead of the indefinite "in Indiis" of the Systema Naturae. It would seem that Erxleben must have actually examined a specimen of *septemcinctus*, either the type or another, in order to have gotten these additional details. Schreber and Gmelin, on the other hand, while they both listed *septemcinctus* as a separate species, apparently were merely following the 1758 edition of the Systema Naturae. Later authors were almost unanimous in throwing the name into the synonymy of *novemcinctus*, although Gray (List Mamm. Brit. Mus., 1843, p. 189) and Turner (Proc. Zool. Soc. London, 1851, p. 212) reversed this procedure and used *septemcinctus* for the nine-banded species. The few specimens of *septemcinctus* that were obtained during the past century were usually considered to belong to *hybridus*, and Gray took the logical step following upon this merging of the two species by considering *hybridus* to be a synonym and *septemcinctus* the valid name of the Argentine animal (Proc. Zool. Soc., 1874, p. 246). Gray's usage did not meet with general acceptance until 1928, when Lönnberg stated that Linnaeus's description agrees with *hybridus*. (Actually it does nothing of the sort, the points of agreement being general ones which apply equally well to several or all of the species in the genus.) Since the publication of Lönnberg's paper, workers on the armadillos have used *septemcinctus* for the Argentine species. All this confusion has been due to the fact that almost no one has realized that the Brazilian and the Argentine animals are two distinct species. Cope and Rhoads saw this, but neither of them realized that the species he supposed to be new was actually the original seven-banded armadillo of Linnaeus.

The seven-banded armadillo is known to hunters throughout most of Brazil. Everywhere one is told of a "tatú" which resembles the nine-banded species but is markedly smaller. Usually the size is the only distinguishing character given, although occasionally a more alert hunter will have noted some of the other differences. Quite often the natives will remark upon a difference in habitat, *novemcinctus* being more common in or close to the forest, while *septemcinctus* prefers the open, grassy campos. The smaller species is usually given its Tupí name, "tatú mirim," meaning literally "the little armadillo." In Pará it is erroneously called "tatú bola;" this is the common name of the three-banded armadillo, which is not found in that region.

The tatú mirim is found over most of Brazil. I have seen specimens with accurate locality records from Pará, Rio de Janeiro, São Paulo, Goyaz, and Matto Grosso; and have seen others which were said to have come from Paraná or Santa Caterina, Minas Geraes, and Bahia. In Rio Grande do Sul and southern Matto Grosso it appears to be replaced by *hybridus*, but I cannot fix the exact boundaries for either species. Specimen number 254980 in the U. S. National Museum, labeled from Panama, apparently belongs to *septemcinctus*; this is the only record, so far as I know, from north of the Amazon.

Dasypus hybridus Desmarest

1804. *Lor[icatus] hybridus* Desmarest, Nouv. Dict. d'Hist. Nat., vol. 24, Tabl. Méthod., p. 28.
1874. *Muletia septemcincta* Gray, Proc. Zool. Soc. London, p. 246.
1928. *Dasypus septemcinctus* Lönnberg, Arkiv Zool., Stockholm, vol. 20A, no. 10, pp. 1–17.

The synonymy of *D. hybridus* is less confused than that of most of the other species of *Dasypus*. No subspecies have been described, and the only change in names was due to the confusion with *septemcinctus*, which we have explained in our account of that species. The present animal is characterized by the short tail, shorter than in any of the other forms, and by the short ears; this latter characteristic is shared however with *D. kappleri*.

This is the "mulita" of the Argentines; it is also called "mulita chica" and "tatú mulita." The Guaraní of Paraguay called it the "tatú mburica." It occurs in Paraguay, in southern Matto Grosso and Rio Grande do Sul, Brazil, in Uruguay, and south to the Rio Negro in Argentina.

Dasypus novemcinctus Linnaeus

1758. *Dasypus novemcinctus* Linnaeus, Systema Naturae, ed. 10, p. 51.
1769. *Tatus minor* Fermin, Descr. gén. Colonie de Surinam, pt. 2, p. 111.
1775. *Dasypus octocinctus* Schreber, Die Säugethiere, pl. 73.
1804. *Loricatus niger* Desmarest, Nouv. Dict. d'Hist. Nat., vol. 24, Tabl. Méthod., p. 28.
1814. *Dasypus serratus* Fischer, Zoognosia, p. 128.
1820. *Dasypus peba* Desmarest, Tabl. Encycl. et Method., Mammalogie, pt. 1, p. 368 (Not of Burmeister, 1854).
1826. *Dasypus longicaudus* Wied, Naturg. Brasiliens, vol. 2, p. 531.
1841. *Dasypus uroceras* Lund, Selskabs Skrifter Danske vidensk. Selskab, naturvid. og math. afd., Copenhagen, vol. 8, p. 65.
1843. *Tatusia septemcinctus* Gray, List spec. Mammalia Coll. Brit. Mus., London, p. 189.
1865. *Dasypus fenestratus* Peters, Monatsber. kais. preuss. Akad. Wiss. Berlin, 1864, p. 180.
1865. *Dasypus novemcinctus mexicanus* Peters, Monatsber. kais. preuss. Akad. Wiss. Berlin, 1864, p. 180.
1871. *Dasypus lundii* Fitzinger, Sitzber. kais. Akad. Wiss. Wien, math.-phys. Cl., vol. 64, p. 340.
1873. *Tatusia platycercus* Hensel, Abhandl. kais. preuss. Akad. Wiss. Berlin, math.-phys. Kl., 1872, p. 105.
1873. *Tatusia granadiana* Gray, Handlist Edentate, thick-skinned and Ruminant Mammals Brit. Mus., p. 14.
1873. *Tatusia brevirostris* Gray, Handlist Edentate, thick-skinned and Ruminant Mammals Brit. Mus., p. 15.
1873. *Tatusia leptorhynchus* Gray, Handlist Edentate, thick-skinned and Ruminant Mammals Brit. Mus., p. 15.
1873. *Tatusia boliviensis* Gray, Handlist Edentate, thick-skinned and Ruminant Mammals Brit. Mus., p. 16.
1873. *Tatusia leptocephala* Gray, Handlist Edentate, thick-skinned and Ruminant Mammals Brit. Mus., p. 16.
1874. *Tatusia leptorhinus* Gray, Proc. Zool. Soc. London, p. 246. (This is a nomen nudum; one of Gray's many aberrations, apparently a mistake for *leptorhynchus*.)
1905. *Tatu novemcinctum texanum* Bailey, North Amer. Fauna no. 25, p. 52.
1908. *Tatusia novemcincta mexianae* Hagmann, Archiv f. rassen- u. gesell. Biologie, vol. 5, p. 29.
1911. *Dasypus novemcinctus hoplites* G. M. Allen, Bull. Mus. Comp. Zool., Harvard College, vol. 54, p. 195.
1913. *Dasypus novemcinctus aequatorialis* Lönnberg, Arkiv Zool., Stockholm, vol. 8, no. 16, p. 34.
1933. *Dasypus mazzai* Yepes, Physis, vol. 11, p. 226. (Type specimen only; the paratype is a new species.)

Discussion of *novemcinctus* seems futile at the present moment. I hope to determine in the near future the extent of individual variation in a large series from a single

locality; and, with this as a standard of comparison, to evaluate the status of the various alleged species and subspecies of nine-banded armadillos.

This species has an amazing distribution. It ranges south into northern Argentina, spreads over all the countries east of the Andes, reaches the Pacific slope in Ecuador, extends throughout Central America and most of Mexico, and at present is spreading north and east in the United States. It has already invaded Oklahoma and Louisiana, at least one has been killed in Kansas, and Florida has been partly colonized by the liberation of some army mascots during the World War (Jour. Mamm., vol. 5, p. 264). Yet, in spite of this dispersion through so many zoogeographical regions, it remains so uniform that it is apparently impossible to find external variations sufficiently constant to be of subspecific rank. Cranial characters appear to offer the only promise for subspecific analysis of the species.

This is the "armadillo" of most spanish-speaking peoples, the "tatú eté," "tatú verdadeiro," or "tatú hu" of the Brazilians and Paraguayans, and the "mulita grande" or "toche" of the Argentines.

Dasypus kappleri Krauss

1848. *Dasypus peba* Cabanis, Schomburgk's Reisen in British Guiana in den Jahren 1840–44, vol. 3, p. 781.
1854. *Dasypus (Praopus) peba* Burmeister, Syst. Uebersicht Thiere Brasiliens, vol. 1, p. 301.
1862. *Dasypus kappleri* Krauss, Archiv f. Naturg., vol. 28, p. 19.
1865. *Dasypus pentadactylus* Peters, Monatsber. kais. preuss. Akad. Wiss. Berlin, 1864, p. 179.
1901. *Tatu pastasae* Thomas, Ann. & Mag. Nat. Hist., ser. 7, vol. 7, p. 370.
1928. *D[asypus] kappleri peruvianus* Lönnberg, Arkiv f. Zool., Stockholm, vol. 20A, no. 10, p. 10.

Burmeister's original designation of this species as *peba* is invalidated by the previous use of this name by Desmarest, 1820, for *novemcinctus*. Cabanis apparently failed to distinguish this animal from *novemcinctus*, and his specimen was lumped together with examples of the nine-banded armadillo under Desmarest's *peba*. Peters's name is an out-and-out synonym, based on a description of Cabanis's specimen. I regard *pastasae* and *peruvianus* as synonyms also, for the characters upon which they were based appear to be merely individual variations. I have personally examined a specimen of *kappleri* in the Museu Goeldii which shows a haphazard mixture of the supposedly diagnostic differences between Krauss's and Thomas's types.

Known range: the Guianas, Pará, and the Amazonian forest region of Ecuador and Peru. Probably occurs throughout the dense forest of the Amazon and Orinoco basins.

This is the "tatú de quinze kilos" (15 kilo armadillo) of the lower Amazon. The Tupí name of "tatú tinga" "white armadillo" may refer to this species.

Dasypus "mazzai" Yepes

1933. *Dasypus mazzai* Yepes, Physis, vol. 11, p. 226. October 30, 1933. (Part.)

This species was described from two specimens taken in Salta, northern Argentina. Through the courtesy of Dr. Jose Yepes, I was able to examine the type and paratype in the collections of the Museo Nacional de Ciencias Naturales in Buenos Aires. The two specimens appear quite dissimilar, and in my opinion the type is a specimen of *novemcinctus*; the paratype, on the other hand, shows characters which clearly establish it as a new species. Unfortunately, the designation of the type specimen in the original description causes the name *mazzai* to fall into the synonymy of *novemcinctus*, so that another designation will have to be given the new species represented by the

present paratype. I understand that Dr. Yepes is re-examining the material with a view to redefining and renaming the species in the near future.

The two most striking characters which are peculiar to the paratype of *mazzai*, and which justify its specific distinction are: the rounded upper edge of the cephalic shield, with absolutely no indication of a separate occipital lobe; and the hexagonal scale-pattern in the central, dorsal third of both scapular and pelvic shields. In the other species of the genus, these show a pattern made up of separated larger scales, each surrounded by a ring of smaller accessory scales which fill in the spaces between the larger ones. This arrangement is still found in the lateral parts of the shields in the *mazzai* paratype, but in the dorsal parts of the shields all the scales are equal hexagons.

Besides these two peculiar characters, "*mazzai*" shows a mixture of characters belonging to the other species. It has seven movable bands, as do *septemcinctus*, *hybridus*, and *kappleri*; the long ears of *septemcinctus* and *novemcinctus*; the tail as in *septemcinctus* and *kappleri*; the tooth formula and scale counts found in *novemcinctus* and *kappleri*; together with the general proportions of head and body found in *hybridus*. The differences between "*mazzai*" and any other one species of the genus are so numerous and striking that I feel no doubt of its validity as a good species, even though it is based on only a single example.

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DOG SKULLS FROM UYAK BAY, KODIAK ISLAND

By Glover M. Allen

Of the many remains of domestic dogs secured in the course of his excavations at the site on Kodiak Island, Alaska, Dr. Aleš Hrdlička has submitted to me for examination a selected series of some thirty crania and a similar number of lower rami. All these specimens, he writes, came from a "great old site in Uyak Bay, Kodiak Island. This site covered over four acres. The accumulations in its central parts reached sixteen feet and reposed directly on glacial till, which, however, in these regions is not very ancient. The dog remains were found scattered throughout the deposits, without any appreciable segregation. One cannot be certain that the animals were there from the very beginning, but they were surely there very early. We estimated the age of the deposits as reaching to about the beginning of the Christian Era, and terminating before or almost immediately after the advent of the Russians (1783). There were many other bones of these animals that we did not collect; but they were all or nearly all scattered and often not in a very good condition. I endeavored to save only what was most diagnostic and in a good state of preservation."

The specimens for the most part fall readily into two groups, representing a larger and a smaller breed of dog. These differ notably in other characters than size, and each shows a fairly strict conformity to type. A few, however, are in certain respects intermediate and probably represent mongrel individuals resulting from occasional crossing of the two breeds. Dr. Hrdlička

adds that his impression is that the larger animals were later than the smaller. Possibly, however, as elsewhere among the American aborigines, both a larger and a smaller breed of dog were maintained, the former occasionally used as a draught animal or for carrying burdens, the latter as a tent or canoe companion or in hunting. The fact of the presence of supposed mongrels would indicate that both breeds were kept at the same time, while disparity of size may have precluded frequent interbreeding. From analogy with other breeds of Indian dogs, we may assume that both were erect-eared, and the smaller animals at least, may have been black and white in patches.

THE LARGER BREED OF DOG

The crania representing the larger dog are slightly less in size than those of modern Eskimo dogs from Greenland with which I have compared them, but otherwise they differ in little except that the muzzle is rather abruptly pinched in at the level of the third upper premolar, instead of tapering gradually forward from the widest point. Among them, some are slightly heavier of bone as well as a trifle larger in dimensions. These possibly are of males; while others somewhat less stout of build and smaller in measurements, may be of females. In several cases, older age is indicated by the loss of some of the premolar teeth, or even of incisors and canines, the alveoli of which are completely filled in with bone, but there were only two or three such. This condition seems common in domestic dogs, indicating the hard use to which teeth are often put in trying to bite away moorings, or from other causes.

In general appearance the skulls present the usual characteristics of larger dogs, with elevated forehead, a well-marked depression in the center of the frontal shield, and, when fully grown, with a low but well-developed sagittal crest formed by the union of the temporal ridges along the mid line of the braincase. This ridge unites at the occiput with the prominent lambdoid ridges to form a backwardly overhanging peak. The most noticeable structural difference in comparison with the crania of the smaller breed of the Kodiak site is the marked elevation of the frontal shield. This is raised and tilted slightly forward by the great development of the frontal sinuses which produce strong convex swellings behind the orbital processes. When viewed from behind, these swellings seem to cause the frontal shield to stand up wing-like, an appearance which is enhanced by the well-marked constriction between them and the anterior end of the braincase. This same type is characteristic of the much smaller terrier-like dogs of the Basket Maker culture of the Southwest, and of other breeds of dogs.

In most of the skulls the incisors, canines and anterior premolars have been lost; but the large upper carnassial, premolar 4, and upper molar 1 are usually in place, since their divergent roots hold them more securely The following table exhibits the main dimensions of length and breadth in these larger skulls, as well as in those of a few specimens of intermediate or mixed

CRANIAL MEASUREMENTS OF LARGER KODIAK DOGS

	257823 U.S.N.M.	257824 U.S.N.M.	257825 U.S.N.M.	257826 U.S.N.M.	260299 U.S.N.M.	260300 U.S.N.M.	260303 U.S.N.M.	260306 U.S.N.M.	260307 U.S.N.M.	260314 U.S.N.M.	260315 U.S.N.M.	260316 U.S.N.M.	260317 U.S.N.M.	AVERAGE	257827 U.S.N.M.	260301 U.S.N.M.	260302 U.S.N.M.
Greatest length, occiput to tip of premaxillary	183.3	190.3	201.0	194.3	200c	180.1	184.2	190.0	182.0	193.4	180.6	183.0	185.3	188.3	177.1	171.0	164.0
Basal length	162.2	168.8	178.5	168.9	—	160.5	161.9	167.9	161.5	168.5	162.2	158.5	166.0	165.4	157.8	147.6	146.8
Palatal length	87.9	93.5	99.1	92.8	—	87.3	89.2	92.5	87.8	96.0	87.4	88.5	91.5	90.3	88.0	82.3	81.7
Length of nasals in median line	57.0	57.6	64.6	61.5	61.7	59.6	56.2	61.5	56.0	63.5	56.9	57.5	59.8	59.5	61.0	52.3	49.8
Occiput to tip of postorbital processes	93.5	92.8	95.6	100.5	98.3	88.8	93.7	95.0	88 ca.	98.5	93.1	90.5	90.4	93.8	84.8	85.5	81.0
Width of frontal shield across postorbital processes	58.5	—	54.2	50.5	54.6	57.0	59.0	56.0	—	50 ca.	55 ca.	52.5	49.5	54.2	—	55.0	54.4
Zygomatic width	—	—	—	—	111.2	—	111.1	112.7	—	—	—	107.0	—	110.4	—	—	98.0
Width of braincase above squamosal	62.4	58.5	61.5	61.1	66.1	60.5	62.0	62.0	58.5	61.5	62.2	70.2	65.5	62.4	56.3	61.0	58.5
Width across occipital condyles	39.0	39.5	39.1	38.2	41.1	38.8	39.1	39.8	37.3	38.8	39.5	37 ca.	40.7	39.0	—	36.2	36.4
Width across first upper molars	65.6	64.6	65.0	62.3	69.8	60.3	64.2	65.7	63.2	63.5	64.3	61.8	62.6	64.0	61.6	59.1	58.5
Length of tooth row, alveoli	89.7	94.9	99.9	93.8	—	89.1	90.4	96.2	92.3	98.5	88.8	90.5	93.8	93.1	90.2	83.7	83.8
Length of upper carnassial	19.6	18.6	19.3	19.3	19.7	—	18.5	19.0	19.3	19.8	19.2	19.1	18.8	19.2	18.6	17.8	17.8

CRANIAL MEASUREMENTS OF SMALLER KODIAK DOGS

	256717 U.S.N.M.	256719 U.S.N.M.	257828 U.S.N.M.	257829 U.S.N.M.	257830 U.S.N.M.	257831 U.S.N.M.	257832 U.S.N.M.	260304 U.S.N.M.	260308 U.S.N.M.	260309 U.S.N.M.	A	B	C	AVERAGE
Greatest length, occiput to tip of premaxillary	150.3	152.6	150.4	145.9	147.0	148.0	163.3	154.2	164.0	157.1	168.0	160.1	—	155.0
Basal length	132.7	134.0	132.8	129.8	130.4	133.5	143.3	138.0	144.5	138.6	147.5	141.1	—	137.2
Palatal length	75.7	73.0	74.9	72.7	72.4	75.4	81.5	77.6	81.2	80.4	81.8	79.2	—	77.1
Length of nasals in median line	—	44.5	45.8	46.2	43.0	45.5	50.9	49.3	52.5	—	54.5	52.6	—	48.5
Occiput to tip of postorbital processes	76.0	78.5	74.7	73.8	74.7	71.3	79.6	75.8	80.4	76.5	83.7	80.5	79.1	77.2
Width of frontal shield across postorbital processes	44.3	45.6	43.0	41.5	49.0	45.0	46.7	45.0	45.7	39.4	45.9	44.7	46.0	44.7
Zygomatic width	91 ca.	91 ca.	—	—	91.3	—	—	91.7	94.5	85.6	—	94.0	93.6	91.6
Width of braincase above squamosal	55.2	53.6	56.0	56.3	56.1	56.3	57.7	55.5	56.8	55.5	55.4	55.6	56.9	55.9
Width across occipital condyles	31.9	30.9	31.5	32.7	32.0	32.7	35.6	33.0	32.5	31.0	34.0	32.5	32.0	32.5
Width across first upper molars	55.0	55.0	52.5	51.9	55.9	55.0	57.0	55.7	56.0	55.5	59.8	54.6	—	55.3
Length of tooth row, alveoli	76.6	77.7	77.1	76.0	72.5	77.4	83.5	77.7	79.0	79.5	84.2	77.6	—	78.2
Length of upper carnassial, pm4	17.3	16.7	17.2	16.0	16.1	16.6	17.5	16.8	16.8	16.8	17.3	16.3	17.4	16.8

type. Since most cranial remains of aboriginal dogs are fragmentary, it seems worth while to publish these details on account of the relative completeness of most of the crania.

In addition to the crania, ten lower rami gave measurements from back of condyle to front border of alveolus of first incisor, varying between extremes of 131.1 mm. to 149.5 mm., with an average of 140.6. The length of the crown of the lower carnassial in these jaws varied from 20.5 to 23.0 mm., with an average length of 21.7 mm.

In further comparison with two Eskimo dog crania from West Greenland, the audital bullae in both the larger and the smaller breeds are much less evenly globular, indeed are distinctly flattened on the ventro-lateral aspect.

THE SMALLER BREED OF DOG

The skulls of the smaller breed of dog agree with those of dogs in general in having a rising profile in the orbital region, but this is less noticeable than in the larger breed. The frontal shield is much more nearly flat, not standing conspicuously up when viewed from behind. It shows little or no median depression, varying a trifle in the different specimens. In further contrast the frontal sinuses are but little developed, so that there is no, or only a slight swelling behind the temporal ridges back of the postorbital processes. There is therefore no hourglass-shaped waist between the latter and the anterior end of the braincase. A more remarkable difference is shown by the outline of the braincase itself as viewed from above; for instead of gradually narrowing anteriorly, the braincase is inflated and extended forward with slightly convex outline to make but a shallow notch behind the postorbital projections.

Compared with a skull representing the little 'Bear Dog,' of British Columbia, regarded as identical with the 'Hare Indian Dog' of Richardson, the smaller Alaskan breed has a much longer muzzle and longer nasals. There is a distinct space between the canine and premolar 1 (if present). In the 'Bear Dog' skull the shortened toothrow brings the canine almost in contact with the second premolar and eliminates the first. Furthermore, it shows a distinct though small postorbital swelling, marked off from the braincase by a waist-like constriction.

In comparison with skulls representing the smaller dog of the 'Basket Maker' culture from Arizona, and with a skull of a similar small breed from a site at La Plata, Colorado, those of the smaller Kodiak dogs, though of practically the same linear dimensions, differ even more widely in their lack of a sagittal ridge, their minimum of postorbital swelling, and especially in the much greater size of the braincase, with its lateral margins extending forward in a convex curve to the root of the postorbital processes; from the latter it is separated by a mere notch instead of a constricted waist. The Kodiak skulls are less heavy of bone than those that I have examined from the California coast, a quality difficult to define, but appealing to the sense of touch.

MONGRELS

In addition to the two well-marked types or breeds to which most of the Kodiak skulls are referred, there are four crania which do not conform closely to either, but show disharmonic or intermediate conditions in some characters. One, no. 257527, is in general similar to the larger type, with prominent sinusal swellings and waist-like constriction behind the orbits, yet it is somewhat smaller than the smallest cranium of the larger breed. Two others, nos. 260301, 260302, are still smaller though markedly larger than those of the lesser breed. They resemble the larger skulls in their more prominently swollen frontal shield, and the marked sinusal development behind orbits, but the form of the braincase is more like that of the smaller dogs in its proportionately greater expansion anteriorly, with less of an hourglass-shaped waist.

Finally, a fourth cranium, no. 260305, has its posterior part from the front of the orbits backward, quite as in the larger breed of dog, with high frontal shield, and swollen sinusal development back of the shield, a forwardly tapering braincase, and well-marked hourglass-like waist between, but the muzzle is very noticeably short, so that the palatal length is about as in the smaller breed; the first premolar is lacking on both sides and the second premolar abuts directly against the canine.

These four skulls, with their mixture of characters of the two types, may doubtless be regarded as mongrels of the two breeds. It is interesting to find that both breeds should have retained so large a proportion of racial distinctness.

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CRATER LAKE PEROMYSCUS

By R. R. Huestis

In connection with the wild life program at Crater Lake National Park I was delegated to determine the taxonomic status and distribution of the deer mouse, *Peromyscus maniculatus*. Three hundred and forty-two specimens were taken during the summer of 1937 and only 22 in 1938. The small number in the second season was due to actual scarcity of mice. All probable adults, as determined by color and by a body length of over 85 mm., were measured and skinned for record. The measurements of the bodies and skins have been statistically analyzed and the results are here presented together with comparable data from other areas in the state and with pertinent data taken from field notes.

In his revision of the genus *Peromyscus*, Osgood (1909) included the Cascade Divide in the region of intergradation between *Peromyscus maniculatus gambeli* and *P. m. rubidus*. On page 69 he made the statement: "The transition from *gambeli* to *rubidus* is rather sudden, suggesting the possibility of hybridizing." However, in his tabulation of specimens examined, he listed as *gambeli* without comment 6 from Anna Creek, Mount Mazama, and 14 from Crater Lake. Concerning 12 taken on Mount Hood he made the remark: "approaching *rubidus*." It was therefore felt that some additional work on the matter would make the status of Cascade Divide deer mice at Crater Lake rather more definite and perhaps add something to our knowledge of intergradation between subspecies in this region.

The largest series (151 mice, 47 adults) was trapped in the Rim Village, an area into which mice immigrate from the surrounding mountain hemlock forest all through the summer. This area lies directly on the divide south of the lake, and has an altitude of 7100 feet. A smaller sample (56 mice—13 adults) was taken on Vidae Ridge, about 5 miles south of the lake, in a dense stand of deer brush (*Ceanothus integerrimus*), occupying an old burn surrounded by a forest of Shasta firs, *Abies shastensis*, and lodgepole pines, *Pinus murrayana*. Its altitude was about 5900 feet; but since the sample did not differ materially from that taken on the rim, the two have been combined as a representative Cascade Divide sample. A further sample (119 mice—27 adults) was taken at the south entrance, in one of the lowest points in the park, 4700 feet. This area, which lies at the foot of the southeast slope of the mountain, was covered with a fairly open forest of young Pacific white firs, *Abies concolor*, and older yellow pines, *Pinus ponderosa*, with scattered clumps of deer brush among the trees. The mice here had relatively shorter tails than the others. Therefore this sample will be treated separately.

For purposes of comparison the character means of the representative Cascade Divide sample have been compared with two samples of *rubidus*; 67 adults taken at Coos Bay on the coast and 51 adults taken west of Rose-

burg in the Umpqua Valley, and with two samples of *gambeli*; 72 adults taken at Silver Lake and 60 adults taken at Narrows, Oregon. These points were chosen because they lie at relatively equivalent latitudes well across the state and well within the boundaries of the ranges of *rubidus* and *gambeli*, respectively (fig. 1).

The objective in the case of all these samplings was the preparation of at least 50 adults for measurement. The mean values for some of the characters studied may fall short of this objective for a number of reasons. Females have feet that are relatively smaller and foot length shows enough sexual difference to necessitate separate computations. A given mean is based, in this character, on the numbers of that sex in the sample. Female mice, incidentally, averaged a little larger and had a shorter relative tail

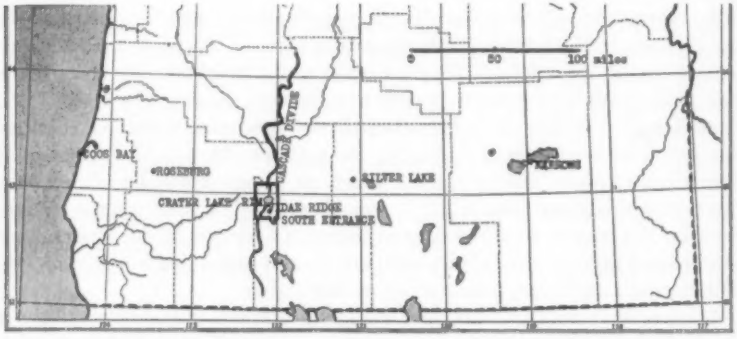

FIG. 1.—Map of the southern half of Oregon showing the places where specimens were collected.

length than males; but the difference is so small that separate computations have not been made for this measurement. Twenty Roseburg mice were trapped as subadults and raised to maturity in the laboratory. Measurement showed that these specimens differed from wild-raised mice in relative tail length. Therefore they are not included in the means of size characters although they are included in pelage color characters in which they did not differ from specimens trapped when adult.

METHODS

Mice were trapped in live traps. Those to be measured were killed by gas and measured immediately. The method of measurement has been used for several years and is believed to be sufficiently standarized to make valid the comparisons of different samples measured by the same observer. Relative tail length (percent of body length) is used in comparisons instead of

actual tail length. Means of size characters have been corrected for a body size of 90 mm., using the regression coeffecient for the correction factor. The amount of correction is usually small since the average body length of all samples is close to 90 mm. and most correlations of extremity and body size are rather moderate. Hair samples are obtained by cutting from the pelage a 2 mm. disc of skin with its attached hairs. Three types of hairs: black overhairs, yellow-banded overhairs, and fur hairs are counted and each expressed as a percentage of the number of hairs in the total sample. Means are then corrected for a hair sample of 400 hairs. Dark mice have more black hairs, pale mice more yellow-banded hairs, so the counts give a numerical indication of pelage color. The number of the smaller fur hairs, which also carry a color band, varies inversely with the number of yellow-banded overhairs, and therefore directly with the black overhairs. All these characters

TABLE 1

Corrected means of body and pelage characters of Cascade Divide *Peromyscus* at Crater Lake and representative *rubidus* and *gambeli* samples. Differences have been entered between each pair of means.

LOCALITY	SUBSPECIES	TAIL PER CENT	FOOT ♀ MM.	FOOT ♂ MM.	EAR, MM.	PERCENT BLACK HAIRS	PERCENT YELLOW HAIRS	PERCENT FUR HAIRS
Coos Bay	*rubidus*	120.8 ±.42	22.5 ±.08	23.0 ±.06	18.1 ±.06	16.0 ±.29	7.5 ±.32	76.8 ±.40
Difference		22.5 ±.80	1.2 ±.14	1.5 ±.11	.9 ±.10	.7 ±.45	1.4 ±.45	2.5 ±.53
Roseburg	*rubidus*	98.3 ±.68	21.3 ±.11	21.5 ±.09	17.2 ±.08	16.7 ±.36	8.9 ±.31	74.3 ±.35
		8.1 ±.85	.6 ±.08	.1 ±.15	.3 ±.09	3.9 ±.50	7.0 ±.51	2.7 ±.52
Crater Lake	intergrade	90.2 ±.51	20.7 ±.07	21.4 ±.12	17.5 ±.06	12.8 ±.34	15.9 ±.41	71.6 ±.38
		5.6 ±.66	.5 ±.09	.6 ±.13	.1 ±.08	3.3 ±.46	7.2 ±.68	4.7 ±.67
Silver Lake	*gambeli*	84.6 ±.42	20.2 ±.06	20.8 ±.05	17.6 ±.06	9.5 ±.32	23.1 ±.54	66.9 ±.55
		1.1 ±.62	.2 ±.10	.4 ±.08	.1 ±.08	0. ±.46	1.4 ±.77	1.1 ±.76
Narrows	*gambeli*	83.5 ±.45	20.4 ±.08	21.2 ±.06	17.7 ±.05	9.5 ±.33	24.5 ±.55	65.8 ±.52

vary, however, to some extent independently of one another. Further discussion of methods, mensural and statistical, can be found elsewhere (Sumner 1920; Huestis 1925).

THE DATA

The means for the several characters in the various samples are presented in Table 1. Differences between any two means, together with their probable errors, are interposed between each pair of means for convenience in making comparisons.

Table 1 shows that in pelage characters the Crater Lake sample is very close to midway between the two *rubidus* samples on the one hand and the two *gambeli* samples on the other. In these characters the two samples in the respective subspecies are rather alike.

With regard to the size characters the Crater Lake sample does not differ from the *gambeli* samples or from the Roseburg *rubidus* in foot length or ear

length. In these two characters the Coos Bay *rubidus* actually differ from Roseburg *rubidus* as well as all the inland samples, the least difference being more than eight times its probable error. The tail percentage in the Crater Lake sample might be said to be somewhat intermediate; but it is fairly close to that in *gambeli*. In this character again the coast *rubidus* mice form the unique group.

SOUTH ENTRANCE MICE

An original intention to take samples from several ecologically different portions of the Park was frustrated by a dearth of specimens in 1938. It has been mentioned that a sample of 27 mice was prepared from an area adjacent to the south entrance and close to the open valley which surrounds Fort Klamath. The figures obtained by measurement of this sample compared with Cascade Divide sample already used are presented in Table 2.

TABLE 2

AREA	PERCENT TAIL	FOOT ♀ MM.	FOOT ♂ MM.	EAR MM.	PERCENT BLACK HAIRS	PERCENT YELLOW HAIRS	PERCENT FUR HAIRS
Divide	90.2 ±.51	20.7 ±.07	21.4 ±.12	17.5 ±.06	12.8 ±.34	15.9 ±.41	71.6 ±.38
South entrance	86.7 ±.75	20.6 ±.15	21.0 ±.08	17.3 ±.10	12.6 ±.44	16.6 ±.56	70.8 ±.78
Differences	3.5 ±.91	0.1 ±.17	0.4 ±.14	0.2 ±.12	0.2 ±.56	0.9 ±.69	0.8 ±.87

Only the mean for tail percent has been "corrected"; all other means agree closely in the two series.

The difference in tail percentage is not quite four times its probable error and therefore cannot be considered a significant difference from the standpoint of conservative statistical analysis. The difference is in the expected direction however and the south entrance mice resemble sagebrush *gambeli* in this character as closely as they do the divide sample. The pelage character differences although small and statistically nonsignificant are also in the direction of *gambeli*.

Brief comment might be interjected here upon the propriety of using the presented samples as representative of *rubidus* and *gambeli* respectively. In color the *rubidus* samples do not differ much from one another and are only a little darker than a sample of *rubidus* taken by Sumner at Carlotta, California on which I have made hair counts. In relative tail length the Roseburg series is a little below average for *rubidus* as judged by comparison with Sumner's measurements of *rubidus* taken at four locations on the California coast and series that I have from Port Orford, Oregon. In size and relative tail length the Coos Bay mice are above average for statistically tested samples of *rubidus*. It seems probable that if there is such a thing as an average *rubidus* sample its character values would lie somewhere between

the values of the samples here presented. The *gambeli* series differ very little from one another, or from two other samples taken in sagebrush in southwest Oregon.

SUMMARY

1. Mice taken on the Cascade Divide at Crater Lake are intermediate between *Peromyscus maniculatus rubidus* and *P. m. gambeli* in pelage characters based on hair count.

2. In mean relative tail length the Cascade Divide sample lies between the means for this character in the *rubidus* and *gambeli* series used for comparison but is much nearer the latter race.

3. In foot and ear length Cascade Divide mice are indistinguishable from *gambeli* and exhibit small differences from *rubidus*.

4. The data show that the point of intergradation is different in the various characters used by taxonomists to separate geographic races.

5. With the exception of a small difference in relative tail length *Peromyscus* taken at three different points in Crater Lake National Park are similar to one another.

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SECTIONS AID IN IDENTIFYING HAIR

By Ned Dearborn

Hairs from different mammals often differ from one another in form and size. Many kinds of mammals in temperate and frigid zones have the equivalent of two coats. The inner one, called underfur, consists of fine short hairs closely packed together. This is a shield against cold and dampness. Scattered among the underfur are coarser and much longer hairs, called guard hairs, which expand in thickness above the underfur to form the outer coat. This outer coat hides the inner one and protects it from wear. Pigments, which give animals their color, are contained in the expanded part of the guard hairs above the underfur.

Underfur hairs and the part of guard hairs surrounded by them are more or less cylindrical, without distinctive form. But the broad portion of guard hairs, above the underfur, may be formed so peculiarly as to be diagnostic of a family or even a genus. Other features of guard hair blades, that may be distinctive, are their size and their medullary pattern. A comparison of these characters of hairs from mammals the world over reveals curious peculiarities in some cases, and interesting parallelisms in others.

The object of this paper is to set forth structural features of guard hairs from mammals of a single region as an aid in identifying hairs of unknown origin, such as may be found in the stomachs and excreta of carnivores. Structural peculiarities can be seen in cross sections and in optical longitudinal sections of guard hair blades. A complete series of cross sections from base to tip of wisps of guard hairs and underfur together, as they grew, shows the relative form, length, and size of these two kinds of hair. Occasionally, among typical guard hairs, will be found one that is larger, longer, and more nearly cylindrical than the ordinary form. These exceptional hairs, which may be termed bristles, are of no use in identification. Guard hairs of young animals increase in size as the animal grows to maturity, without a change of form.

A convenient plan to pursue is to make in advance, camera lucida drawings of cross and optical longitudinal sections of hair from all of the more obscure mammals found in a given vicinity, as appear in figure 1 By arranging such drawings in a vertical column, they can be run along beneath the mirror of the camera lucida and compared in turn with sections of an unknown hair under the microscope. Unless the magnification of the unknown hair is the same as that used in making the drawing, identification is questionable, inasmuch as *size* is important as well as *form*. Thus it is possible to superimpose the image of the unknown hair on any of the series of drawings. Very often identity can be established by size and form of cross section alone. When different species of mammals have hair similar in form and size, recourse must be had to optical longitudinal sections, which show the medullary

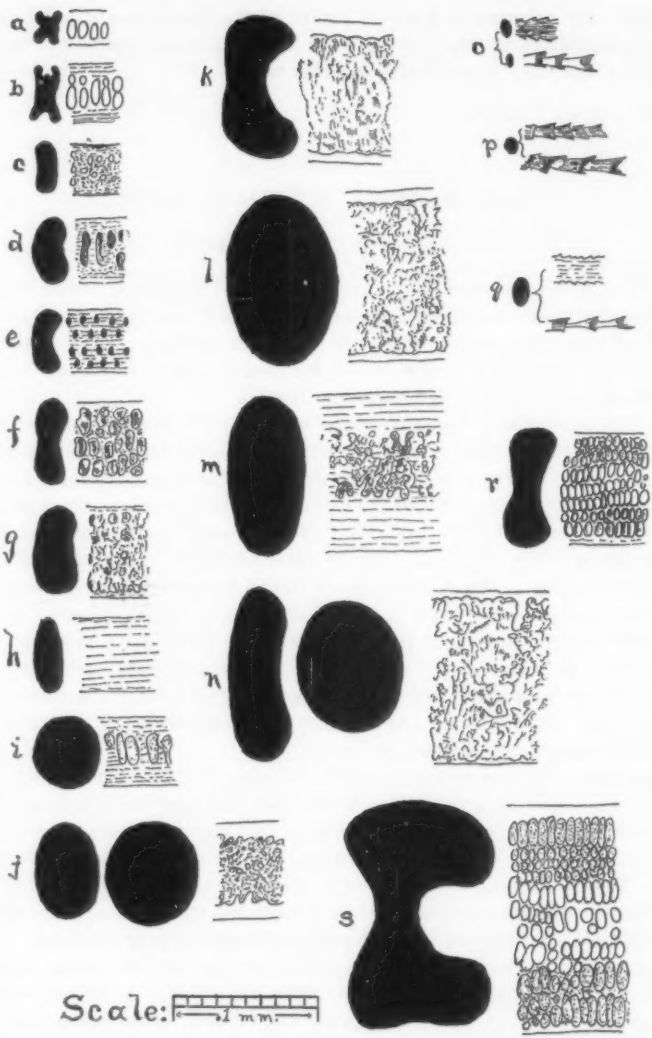

FIG. 1. Cross, and optical longitudinal sections of guard hairs from 19 rodents and insectivores found in northeastern United States. The species represented here are: a, *Sorex cinereus;* b, *Blarina brevicauda;* c, *Glaucomys volans;* d, *Peromyscus leucopus;* e, *Mus musculus;* f, *Pitymys pinetorum;* g, *Microtus pennsylvanicus;* h, *Scalopus aquaticus;* i, *Condylura cristata;* j, *Tamias striatus;* k, *Citellus tridecemlineatus;* l, *Zapus hudsonicus;* m, *Ondatra zibethica;* n, *Rattus norvegicus;* o, *Lasionycteris noctivagans;* p, *Nycteris borealis;* q, *Myotis lucifugus;* r, *Lepus americanus;* s, *Sylvilagus floridanus.*

patterns. By referring to figures l and m of the illustration it will be noted that the medullary arrangement of hairs from *Zapus* and *Ondatra* is far more distinctive than the form or size of cross sections.

Hilton Village, Virginia

NOTES ON SOREX MERRIAMI DOBSON

By Seth B. Benson and Richard M. Bond

Study of specimens of shrews recently obtained in California has led us to conclude that *Sorex merriami* Dobson and *Sorex leucogenys* Osgood are subspecies of the same species rather than distinct species. Because *merriami* has priority the names of the two forms become *Sorex merriami merriami* Dobson and *Sorex merriami leucogenys* Osgood.

The first specimen of *Sorex merriami merriami* collected in California was taken on October 8, 1935, in Indian Well Cave, Lava Beds National Monument, Siskiyou County, by Annie M. Alexander and Louise Kellogg. This locality is near the upper limit of the Upper Sonoran life-zone. On August 12, 1937, Bond made a collection of about 1400 barn owl and horned owl pellets at Petroglyph Cliffs, approximately 10 miles northeast of Indian Well Cave, in Modoc County. This locality also is in the Upper Sonoran life-zone, but somewhat lower zonally than Indian Well Cave. Among remains of more than 3000 mammals present in the pellets were incomplete skulls of three shrews, two *Sorex merriami* and one *S. vagrans amoenus* Merriam. The former are the first shrews of this species recorded from California (Bond, 1939, p. 58). As far as we know, these three specimens of true *merriami* are all that have been collected in the state.

Inasmuch as *Sorex merriami*, until the present, has been known only from very meager material, and in view of the fact that the new localities are on the southern margin of the known range of true *merriami*, hence close to the area occupied by *S. leucogenys*, we made a careful comparison of the two forms. The specimens, together with the data given by Jackson (1928), show that the differences between them is even less than indicated by Benson (1935, p. 447), and that in some characters there is intergradation.

Our evidence concerning the relationship between the two forms is better than that available to Jackson when he revised the North American members of the genus. He had only five imperfect specimens of *merriami*, and only three specimens of *leucogenys*. We have available, in addition to the data given by Jackson, three specimens of *merriami* and eight of the ten known specimens of *leucogenys*. It is interesting to note that of the eighteen specimens so far extant of these shrews, half of them have been trapped by Miss Alexander and Miss Kellogg. Of the remaining nine, four were taken by four

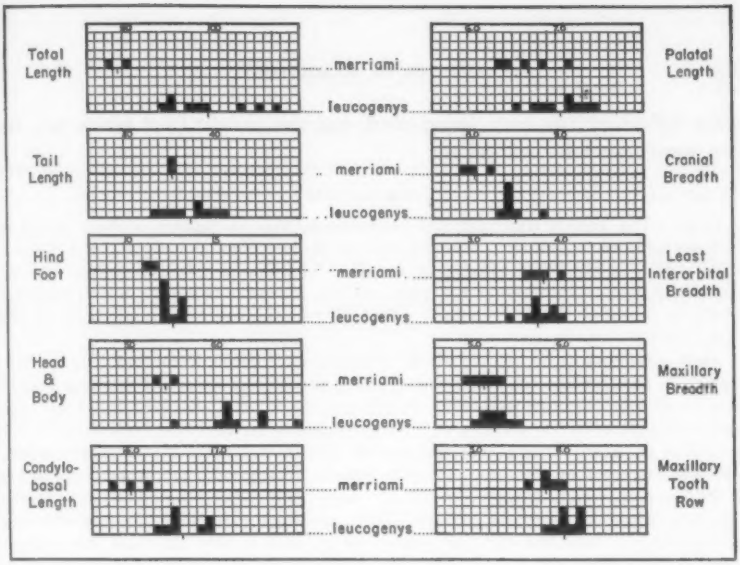

FIG. 1. Comparison of measurements (in millimeters) of all recorded specimens of *Sorex merriami merriami* and *Sorex merriami leucogenys*.

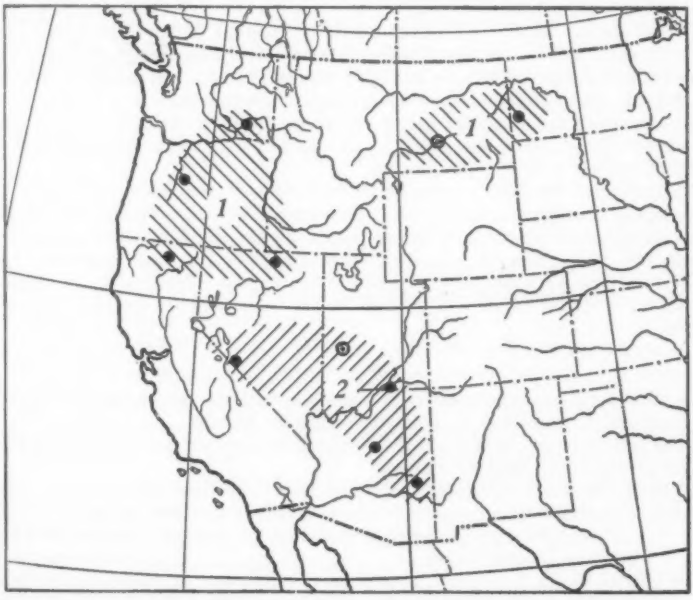

FIG. 2. Geographic range of subspecies of *Sorex merriami*. Encircled dots are type localities, solid circles are other stations of occurrence. 1. *Sorex merriami merriami*. 2. *Sorex merriami leucogenys*.

other collectors, two were found dead, one was caught by a house cat, and two were found in owl pellets.

COMPARISONS

Color.—The Indian Well specimen conforms to the description of color given by Jackson for *Sorex merriami*. It is paler on the dorsum than at least one of five specimens of *S. leucogenys* from Navajo Mountain, Utah, among which there is much individual variation. The color of the dorsal surface of the tail is darker in *merriami* than in any of the specimens of *leucogenys*, although two approach *merriami* closely in this character.

Skull.—Jackson (1928, p. 79) wrote of *merriami:* "Skull somewhat smaller than that of *S. leucogenys*, with flatter brain case and anterior halves of unicuspid tooth rows more approximated and more nearly parallel." The shape of the brain case cannot be determined in the two owl-pellet specimens because they lack the posterior portion of the skull. The general shape of the skull of the Indian Well specimen is as ascribed to *merriami*, but, as pointed out by Benson (1935, p. 447), so are the skulls of two of the *leucogenys* from Navajo Mountain. These three specimens show considerable variation in the degree of straightness of the maxillary tooth row. In this character the specimens of *merriami* and *leucogenys* overlap considerably although the averages in the two are different. One or both of the dentaries of each of the three *merriami* is complete and these average a little smaller than those of *leucogenys*, but here, too, there is overlapping.

Measurements.—Adult female, no. 68848 Mus. Vert. Zool., from Indian Well Cave: Total length, 88; tail, 35; hind foot, 11; ear from crown, 4; weight in grams, 3.4. *Skull*, nos. 68848 (Indian Well Cave), 84276 and 84277 (Petroglyph Cliffs), respectively: Condylobasal length, 16.0, —, —; palatal length, 6.8, 7.1, 6.6; cranial breadth, 8.2, —, —; least interorbital breadth, 3.6, 3.7, —; maxillary breadth, 5.2, 5.3, 4.9; maxillary tooth row, 5.9, 6.0, 5.8. Wear on teeth, respectively: Slight, heavy, none.

In comparing the measurements of all the specimens of *Sorex merriami merriami* with those of *S. m. leucogenys*, it will be seen that in many of the measurements there is either overlap or close approach.

There are too few body measurements of *Sorex merriami merriami* to make these comparisons of as much value as the skull measurements. On the basis of the specimens at hand, *S. m. leucogenys* is actually larger in total length, hind foot, condylobasal length, and cranial breadth, and it averages larger in all measurements except least interorbital breadth, a dimension of doubtful significance. Relatively to condylobasal length, however, the palate of *S. m. merriami* is longer and the maxillary breadth is greater.

CONCLUSION

In view of the evidence available we conclude that the shrews described as *Sorex merriami* and *S. leucogenys* are only subspecifically distinct.

That part of Jackson's key (p. 33) differentiating between these forms may be still further altered (from Benson), to read:

g.[2] Hind foot 13 or less; palatal length more than 6; maxillary breadth 4.9 or more.

h.[1] Total length 90 or less, condylobasal length 16.2 or less; cranial breadth 8.2 or less; known geographic range from north of about 40° north latitude in the western United States.....*merriami* (p. 78).

h.[2] Total length 93 or more; condylobasal length 16.3 or more; cranial breadth 8.3 or more; known geographic range from south of about 40° north latitude in the western United States.....*leucogenys* (p. 81).

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Museum of Vertebrate Zoology, Berkeley, California, and Soil Conservation Service, Berkeley, California

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NINE NEW MAMMALS FROM ISLANDS IN GREAT SALT LAKE, UTAH

BY E. A. GOLDMAN

In a previous paper (Proc. Biol. Soc. Washington, vol. 50, pp. 221–226, December 28, 1937) I referred briefly to the extraordinary combination of conditions that has led to the differentiation of certain small mammals inhabiting islands in Great Salt Lake, Utah. Of the three new insular forms then described two were based on collections made early in June, 1937, on Gunnison Island by Alfred M. Bailey and Robert J. Niedrach of the Colorado Museum of Natural History; and one on specimens taken later in the same month on Bird Island, by W. H. Marshall, of the Biological Survey.

During the summer of 1938 a field party headed by Mr. Marshall revisited Bird Island and collected mammals there and on most of the other islands in Great Salt Lake, as well as in some of the mountains of the adjacent mainland. The result of this later work is a further demonstration of the rôle of insularity in the evolution of species.

Some of the so-called "islands" in Great Salt Lake are at least periodically connected with the mainland or with neighboring islands; others have been more continuously separated during recent times. The measure of each island's isolation appears to be reflected in the degree of differentiation presented by its small mammals Nine forms, regarded as subspecies, are here described as new. A more detailed account of the distribution and ecological relationships of the mammals obtained by the party is to be prepared for publication by Mr. Marshall.

Descriptions of colors in quotation marks are from Ridgway's "Color Standards and Nomenclature," 1912. All measurements are given in millimeters.

Perognathus parvus plerus, subsp. nov.

Stansbury Island Pocket Mouse

Type.—From north end of Stansbury Island, Great Salt Lake, Utah (altitude 4,250 feet). No. 263971, ♂ old adult, skin and skull, U. S. National Museum (Biological Survey collection); collected by William H. Marshall, June 23, 1938.

Distribution.—Known only from Stansbury and Carrington Islands in Great Salt Lake. These islands are connected, at least periodically, with one another by salt flats, which also extend to the mainland.

General characters.—Closely allied to *Perognathus parvus olivaceus* of the adjacent mainland, but color paler, the buffy element on upper parts lighter in tone, and dorsum less profusely "lined" with black; no distinctive skull characters.

Color.—Type: Upper parts "pinkish buff," purest on cheeks and along sides of body to thighs, the top of head and back thinly lined with black: under parts white; black facial markings distinct; ears dusky, edged with white, the subauricular white spots conspicuous; fore limbs white, except a narrow, "pinkish buff" line along outer sides of forearms to wrists; hind feet white; tail light brownish above, white below. *Young* (about two-thirds grown): Upper parts pale buffy, moderately mixed with black (much paler than in *olivaceus* of corresponding age).

Skull.—As in *olivaceus.*

Measurements.—Type: Total length, 174; tail vertebrae, 91; hind foot, 24. Two adult male topotypes, respectively: 174, 163; 84, 74; 23, 23. An adult female topotype: 164, 86, 22. *Skull* (type [♂] and an adult female topotype, respectively): Occipitonasal length, 27.7, 27; mastoid breadth, 13, 13.3; interorbital constriction, 5.7, 5.7; length of nasals, 11.4, 10.6; interparietal, length, 3.1, 3.2, width, 5.3, 5.2; maxillary tooth row (alveoli), 3.7, 3.2.

Remarks.—Perognathus parvus plerus is distinguished by predominantly clear pinkish buff coloration. In *P. p. olivaceus* of the mainland the buff is a darker, more vivid tone between "pinkish buff" and "cinnamon-buff," and the back is more obscured by black.

Specimens examined.—Five, from islands in Great Salt Lake, as follows: Carrington Island, 1; Stansbury Island, 4.

Dipodomys ordii cineraceus, subsp. nov.

Dolphin Island White-pouched Kangaroo Rat

Type.—From Dolphin Island, Great Salt Lake, Utah (altitude 4,250 feet). No. 263890, ♂ adult, skin and skull, U. S. National Museum (Biological Survey collection); collected by William H. Marshall, June 4, 1938. Original number 57.

Distribution.—Known only from Dolphin Island.

General characters.—A pallid subspecies, allied to *Dipodomys ordii utahensis* of the adjacent mainland, but much paler, black facial markings indistinct or absent, tail shorter, and skull slightly different. Similar in size and general pallor to *Dipodomys ordii marshalli* of the islands in the southwestern part of Great Salt Lake, but buffy element in upper parts more ashen, less vivid in tone; mastoid and auditory bullae slightly larger.

Color.—Type: Upper parts near "pale pinkish buff," inconspicuously mixed with brownish black, the combination resulting in a somewhat grayish general tone; no black facial markings (usually present in forms of *ordii*). Entire under parts, sides of head and areas encircling eyes, hip stripes, fore and hind limbs, including palms and soles, white; tail above light brown, mixed with gray, below tinged with brown near

base, the remainder of lower surface and sides white. Upper parts in some specimens varying to dull pinkish buff.

Skull.—Very similar to that of *D. ordii utahensis*, but shorter and relatively broader across bullae; supraoccipital broad, much as in *utahensis*. Similar in size to that of *marshalli*, but bullae usually slightly larger, and supraoccipital slightly broader.

Measurements.—Type: Total length, 231; tail vertebrae, 130; hind foot, 37. Average of three adult topotypes: 231 (228–235); 128 (124–132); 37.5 (36–39). *Skull* (type and an adult female topotype, respectively): Occipitonasal length, 35.7, 34.9; greatest breadth (between outer sides of auditory bullae), 23.8, 23.6; breadth across maxillary arches, 20.1, 20; length of nasals, 13.8, 13.6; width of nasals (in front of incisors), 3.5, 3.6; least width of supraoccipital (near interparietal), 2.9, 2.9; maxillary tooth row (alveoli), 5.1, 4.6; width of cutting edge of upper incisors, 1.8, 1.8.

Remarks.—Dipodomys ordii cineraceus differs markedly in coloration from *utahensis*, but its island habitat is reported to be connected periodically with the mainland. Rather close alliance with *D. o. utahensis* is shown in cranial details.

Specimens examined.—Six, all from the type locality.

Dipodomys microps russeolus, subsp. nov.

Dolphin Island Black-pouched Kangaroo Rat

Type.—From Dolphin Island, Great Salt Lake, Utah (altitude 4,250 feet). No. 263895, ♂ adult, skin and skull, U. S. National Museum (Biological Survey collection); collected by William H. Marshall, June 5, 1938. Original number 65.

Distribution.—Known only from Dolphin Island, which at the present time is connected with the mainland several miles away by a low bar not likely to be attractive to kangaroo rats.

General characters.—Similar to *Dipodomys microps bonnevillei* of the adjacent mainland, but upper parts more rufescent; tail apparently shorter; skull more elongated. Much smaller than *Dipodomys microps alfredi* of Gunnison Island; color more rufescent; skull differing in detail.

Color.—Upper parts near "pinkish cinnamon," purest on cheeks, flanks, and thighs, the top of head and back moderately mixed with black; under parts, postauricular and supraorbital spots, fore limbs, hind feet above, hip stripes, and tail at extreme base all around, pure white; tail beyond base brownish above and below, the sides abruptly becoming white, and the white under color showing through the tuft at tip, as usual in the group; soles of hind feet blackish to base of toes, which are white; ears black, crossed by the usual median white band; cheek pouches lined with black anteriorly; black marking across muzzle as usual in the group.

Skull.—Similar to that of *D. m. bonnevillei*, but more elongated; rostrum and nasals longer; auditory bullae less fully inflated; dentition about as in *bonnevillei*. Compared with that of *alfredi* the skull is much smaller; outer angles of maxillary arches more rounded; incisors relatively narrower.

Measurements.—Type: Total length, 248; tail vertebrae, 136; hind foot, 41. *Skull* (type): Occipitonasal length, 36; breadth (between outer sides of auditory bullae), 24.1; breadth across maxillary arches, 19.3; length of nasals, 12.5; width of nasals (in front of incisors), 3.7; least width of supraoccipital (near interparietal), 2.4; maxillary tooth row (alveoli), 4.5; width of cutting edge of upper incisors, 2.4.

Remarks.—Dipodomys microps russeolus is based on a single specimen presenting characters that seem to be beyond the usual range of individual variation. Its restricted insular habitat is shared with *Dipodomys ordii cineraceus*, but the animal is distinguished from that form by larger size, darker upper parts, and the blackish instead of pure white lining of cheek pouches.

Dipodomys microps subtenuis, subsp. nov.

Carrington Island Black-pouched Kangaroo Rat

Type.—From Carrington Island, Great Salt Lake, Utah (altitude 4,250 feet). No. 263917, ♀ adult, skin and skull, U. S. National Museum (Biological Survey collection); collected by William H. Marshall, June 30, 1938. Original number 182.

Distribution.—Known only from Badger, Carrington, and Stansbury islands, in the southwestern part of Great Salt Lake.

General characters.—Similar in size to *Dipodomys microps bonnevillei* of the adjacent mainland, but color somewhat paler; skull with longer, more slender rostrum. Somewhat resembling *Dipodomys microps alfredi* of Gunnison Island in color, but much smaller; skull contrasting strongly in its slenderness

Color.—*Type* (acquiring fresh pelage): Upper parts near "pinkish buff," moderately mixed with black; under parts, postauricular and supraorbital spots, fore limbs, hind feet above, hip stripes, and tail at extreme base all around pure white; tail beyond base brownish above and below, the sides changing abruptly to white along lines narrowing gradually to a subterminal point where the tail becomes dark all around, the lengthening hairs from there to tip, however, only partially concealing the white under color; soles of hind feet blackish to base of toes, which are white; black facial mask distinct; ears blackish, crossed by the usual white median band; cheek pouches blackish internally, the black showing along external margins.

Skull.—Similar to that of *bonnevillei*, but longer; rostrum and nasals longer, more slender; maxillary arches more extended antero-posteriorly, the external angles less rounded and more hook-like; bullae and dentition about the same. Compared with that of *alfredi* the skull is similar in general form, but much smaller and slenderer.

Measurements.—Type: Total length, 267; tail vertebrae, 157; hind foot, 40. An adult male from Stansbury Island, 269; 152; 40. *Skull* (type): Occipitonasal length, 36.7; greatest breadth (between outer sides of auditory bullae), 23.8; breadth across maxillary arches, 19.8; length of nasals, 13.3; width of nasals (in front of incisors), 3.6; least width of supraoccipital (near interparietal), 1.4; maxillary tooth row, 4.6; width of cutting edge of upper incisors, 2.4.

Remarks.—Dipodomys microps subtenuis is most closely allied to *D. m. bonnevillei* of the adjacent mainland. The islands of the group it inhabits are periodically land-connected with one another and the largest, Stansbury Island, is isolated from the mainland only at long intervals. Salt flats, however, apparently present a partial barrier and limit range contact with the mainland for *subtenuis* and for *Dipodomys ordii marshalli* which shares the same insular habitat.

Specimens examined.—Three, all from islands in Great Salt Lake, Utah, as follows: Badger Island, 1; Carrington Island, 1; Stansbury Island, 1.

Onychomys leucogaster utahensis, subsp. nov.

Stansbury Island Grasshopper Mouse

Type.—From south end of Stansbury Island, Great Salt Lake, Utah (altitude 4,250 feet). No. 263955, ♀ adult, skin and skull, U. S. National Museum (Biological Survey collection); collected by William H. Marshall, June 22, 1938. Original number 96.

Distribution.—Known only from Stansbury Island.

General characters.—Closely allied to *Onychomys leucogaster brevicaudus* of the adjacent mainland, but general coloration of upper parts grayer, less brownish or blackish; ear tufts whiter; skull as in *brevicaudus*. Decidedly smaller and grayer than *Onychomys leucogaster melanophrys* of southern Utah.

Color.—Type (unworn pelage): Upper parts "pale pinkish buff" thinly overlaid with

brown, giving the resulting mixture a somewhat grayish buff general tone; under parts below a sharp line of demarcation, including muzzle, cheeks, fore arms, and fore and hind feet, white; a small tawny spot on middle of chest; exposed parts of ears blackish with silvery white margins, the tufts on anterior base white; tail indistinctly brownish above, white below. Young in first pelage distinctly grayish above.

Skull.—As in *brevicaudus*. Differs from that of *melanophrys* in smaller size, especially the shorter rostrum; dentition lighter.

Measurements.—Type: Total length, 128; tail vertebrae, 39; hind foot, 18. *Skull:* Occipitonasal length, 26.3; zygomatic breadth, 14.5; interorbital breadth, 5; width across squamosals (over mastoids), 11.7; length of nasals, 10; maxillary tooth row, 3.8.

Remarks.—Like several other small mammals that share the same habitat, *Onychomys leucogaster utahensis* is distinguished by pallid coloration. It is based on two specimens, one of these a young individual, differing like the adult in pallor as compared with *brevicaudus* of corresponding age.

Reithrodontomys megalotis ravus, subsp. nov.

Stansbury Island Harvest Mouse

Type.—From north end of Stansbury Island (sandbar at springs on lake shore), Great Salt Lake, Utah (altitude 4,250 feet). No. 263963, ♂ adult, skin and skull, U. S. National Museum (Biological Survey collection); collected by William H. Marshall, June 26, 1938.

Distribution.—Stansbury Island and the adjacent mainland shore of Great Salt Lake.

General characters.—Closely allied to and doubtless intergrading with the widely dispersed *Reithrodontomys megalotis megalotis* but color of upper parts duller, more grayish, lacking the ochraceous buffy suffusion characterizing that form; tail shorter; skull rather short and broad.

Color.—Type (summer pelage): Upper parts grayish buff, or buffy gray, purest along flanks, the top of head and back moderately mixed with black; under parts overlaid with dull white, the dark under color showing through, except on chin where the short hairs are white to roots; ears brownish; outer sides of forearms about like flanks; feet white; tail brownish above, white below.

Skull.—Closely resembling that of *megalotis* but apparently slightly shorter and relatively broader, with rather low braincase.

Measurements.—Type: Total length, 137; tail vertebrae, 59; hind foot, 16. An adult male topotype: 138; 66; 16. *Skull* (an adult male from Grantsville, Utah): Occipitonasal length, 20.7; zygomatic breadth, 10.8; breadth of braincase, 10.2; interorbital constriction, 3.4; length of nasals, 8.2; maxillary tooth row, 2.8.

Remarks.—Reithrodontomys megalotis ravus is obviously very closely allied to typical *megalotis*, but in coloration, the specimens from Stansbury Island and the shores of Great Salt Lake exhibit a departure from that form. Specimens from Salt Lake City and the mouth of Bear River, however, suggest intergradation. No close comparison with other subspecies of *megalotis* is required.

Specimens examined.—Total number, 11, all from the Great Salt Lake region, Utah, as follows: Grantsville (20 miles west), 1; mouth of Bear River (Duckville Gun Club), 5; Salt Lake City, 2; Stansbury Island, 3.

Peromyscus maniculatus inclarus, subsp. nov.

Fremont Island White-footed Mouse

Type.—From Fremont Island, Great Salt Lake, Utah (altitude about 4,250 feet). No. 264119, ♂ adult, skin and skull, U. S. National Museum (Biological Survey collection); collected by William H. Marshall, August 7, 1938. Original number 276.

Distribution.—Known only from Fremont Island.

General characters.—Closely allied to *Peromyscus maniculatus sonoriensis* of the adjacent mainland, but color uniformly duller, less buffy; skull slightly heavier. Much darker than *Peromyscus maniculatus gunnisoni* of Gunnison Island, in the western part of Great Salt Lake.

Color.—*Type* (summer pelage): Upper parts near "light drab," slightly modified by buff, the top of head and back rather heavily lined with black; under parts, forearms, and feet white; ears brownish, indistinctly edged with white; tail sharply bicolor, black along median line above, white on sides and below.

Skull.—Very similar to those of *sonoriensis* and *gunnisoni*, but somewhat heavier than either; rostrum slightly broader; nasals usually broader, less tapering anteriorly, tending to extend farther posteriorly beyond premaxillae (nasals and premaxillae nearly conterminous in *sonoriensis* and *gunnisoni*).

Measurements.—*Type:* Total length, 158; tail vertebrae, 62; hind foot, 21. Average of four adult topotypes: 164 (161–169); 65 (62–67); 20 (20–21). *Skull* (type): Occipitonasal length, 26.5; zygomatic breadth, 13.1; interorbital breadth, 3.9; length of nasals, 11.1; length of incisive foramina, 5.6; length of palatal bridge, 4.9; maxillary tooth row (alveoli), 3.8.

Remarks.—The characters, mainly color, distinguishing this insular form from widely dispersed *sonoriensis* are rather slight. The series of specimens available, however, is uniformly duller in tone and lacks the brighter buff element as shown, for example, in those taken at Promontory Point, on the mainland, only three and one-half miles north of the type locality, but across deep water. A bar, temporarily uncovered for short periods at infrequent intervals, connects the island with the mainland about 20 miles to the east. Possible invasion of the island from the mainland has evidently not sufficed to prevent the development of a locally differentiated race.

Specimens examined.—Nine, from the type locality.

Peromyscus crinitus pergracilis, subsp. nov.

Stansbury Island Canyon Mouse

Type.—From south end of Stansbury Island, Great Salt Lake, Utah (altitude 4,250 feet). No. 264022, sex undetermined, skin and skull, U. S. National Museum (Biological Survey collection); collected by William H. Marshall, June 22, 1938. Original number 100.

Distribution.—Known only from Stansbury Island.

General characters.—Allied to *Peromyscus crinitus crinitus* of Idaho and to *Peromyscus crinitus peridoneus* of Arizona and southwestern Utah, but contrasting strongly with both of these races in its pallid coloration; skull slenderer and differing in detail. Differing from *Peromyscus crinitus auripectus* of southeastern Utah in smaller size, and much paler "pinkish buff," instead of deep "ochraceous buff" upper parts; cranial characters also distinctive.

Color.—*Type* (summer pelage): Upper parts in general near "pinkish buff," purest on cheeks, shoulders and outer sides of forearms, flanks, thighs, and posterior part of rump, the top of head and back thinly mixed with black; under parts, except a small "pale pinkish buff" area across chest, overlaid with white; more exposed parts of ears light brown, the longer hairs covering basal portions whitish or light buffy; feet white; tail bicolor, light brown above, white below.

Skull.—Similar in general to the skulls of *peridoneus* and *auripectus*, but braincase more flattened; frontals narrower, less excavated along median line anteriorly; rostrum more cylindrical, the vertical diameter less behind incisors; nasals less decurved anteriorly; molar tooth rows shorter. Compared with that of typical *crinitus* the inter-

parietal is less extended antero-posteriorly; and the skull differs otherwise in the same characters as from *peridoneus* and *auripectus*.

Measurements.—Type: Total length, 169; tail vertebrae, 80; hind foot, 19. *Skull* (type): Occipitonasal length, 24.8; zygomatic breadth, 12.2; interorbital breadth, 4.1; length of nasals, 9.2; length of incisive foramina, 4.9; length of palatal bridge, 3.5; maxillary tooth row (alveoli), 3.1.

Remarks.—Peromyscus crinitus pergracilis is based on a single specimen which differs so appreciably from the forms of *crinitus* hitherto recognized that, especially in view of the isolated habitat, recognition of a new subspecies seems warranted. Stansbury Island, so-called, isolated in the past by water is now connected by sand bars and salt flats with the mainland, but Marshall's report indicates that the part of the island which would attract this rock-inhabiting mouse lies about 12 miles from the nearest rocky area on the mainland. The island is more fully occupied by *Peromyscus maniculatus sonoriensis*, the local colony of which, representing a species more general in local distribution, is not appreciably different from the mainland population.

Neotoma lepida marshalli, subsp. nov.

Carrington Island Wood Rat

Type.—From Carrington Island, Great Salt Lake, Utah (altitude about 4,250 feet). No. 263984, ♀ adult, skin and skull, U. S. National Museum (Biological Survey collection); collected by William H. Marshall, July 2, 1938. Original number 216.

Distribution.—Known only from Carrington and Stansbury Islands, in the southwestern part of Great Salt Lake. Carrington Island is periodically connected with Stansbury Island and the latter is at present joined to the mainland about 12 miles distant by low sand bars and salt flats uninviting to wood rats.

General characters.—Closely allied to *Neotoma lepida lepida* of the adjacent mainland but larger than usual in that form, and upper parts paler buff, less extensively overlaid with black.

Color.—Type: Upper parts "pale pinkish buff," purest on cheeks, outer sides of forearms, along flanks, and on thighs, the top of head and back thinly lined with black; under parts pure white to roots of hairs on chest, inner sides of fore legs, and inguinal region, the "mouse gray" under color showing through across abdomen; ears thinly clothed externally with short brownish hairs, internally with grayish hairs; vibrissae blackish basally, becoming paler toward tips; feet white; tail sharply bicolor, brownish above, white below.

Skull.—About like that of typical *lepida*, but larger.

Measurements.—Two adult male topotypes, respectively: Total length, 298, 304; tail vertebrae, 132, 135; hind foot, 34, 34. *Skull* (type [♀] and an adult female topotype, respectively): Occipitonasal length, 41.9, 42.5; zygomatic breadth, 22.7, 22.3; width of braincase (at constriction between zygomata and bullae), 16.6, 15.5; interorbital breadth, 5.6, 5.3; length of nasals, 16.3, 16.4; length of incisive foramina, 8, 8; length of palatal bridge, 7.8, 8.5; maxillary tooth row (alveoli), 8.5, 8.2.

Remarks.—Neotoma lepida marshalli is a well-marked subspecies, characterized by the pale coloration distinctive of other small mammals that share its insular habitat. The larger size of the insular specimens, in comparison with specimens of typical *lepida*, seems more noticeable in the skull than in other parts.

Specimens examined.—Total number, 9, from islands in Great Salt Lake, Utah, as follows: Carrington Island (type locality), 7; Stansbury Island, 2.

Bureau of Biological Survey, Department of Interior, Washington, D. C.

A NEW SUBSPECIES OF BEAVER FROM COLORADO

By Edward R. Warren and E. Raymond Hall

The beaver of the state of Colorado generally has been referred to in literature as *Castor canadensis frondator* Mearns. Although the senior author himself has employed this name, it has been with mental reservations because *C. c. frondator* is based on beavers taken in the San Pedro River, Sonora, Mexico, and it was known that in almost every other species of mammal that occurs in both Mexico and Colorado, the populations in the two regions were subspecifically different. As a means of settling this question of the correct name of the Coloradan beaver, specimens have been saved whenever dead individuals have been found. The material accumulated in this fashion is mostly skulls and skeletons. This has been supplemented by similar material from the University of Colorado Museum, kindly loaned by Dr. Hugo G. Rodeck, and by specimens in the University of California Museum of Vertebrate Zoology. Comparison, at the last mentioned museum, of all this material with specimens of geographic races named from adjoining regions, shows that the Coloradan beavers belong to an unnamed subspecies, which may be known as:

Castor canadensis concisor, new subspecies

Type.—Probably male, adult, skull and partial skeleton; no. 84521, Mus. Vert. Zool.; Monument Creek, southwest of Monument, El Paso County, Colorado; picked up dead November 20, 1935; original no. 4416, E. R. Warren.

Range.—Known definitely from Jackson, Boulder, Jefferson, El Paso, Mesa, Delta, and Gunnison counties, Colorado; limits of range unknown.

Diagnosis.—Color dark, between Cinnamon-Brown and Prout's Brown above (color terms are of Ridgway: Color Standards and Color Nomenclature, 1912); skull with rostrum and nasals broad; postorbital processes on jugal strongly developed; in specimens taken at the type locality, distal end of meatal tube massive, and angular process of mandible extended far posteriorly and pointed.

Comparisons and remarks.—This race has a skull essentially like that of *Castor canadensis mexicanus* Bailey, but the skin color is much darker and to us is indistinguishable from that of *Castor canadensis taylori* Davis, from central Idaho. Having established these facts and satisfied ourselves that the Coloradan animals were not referable to any other subspecies, our first inclination was to treat them as intergrades and refer them either to *mexicanus* or to *taylori*. Additional study decided us against this reference and led us instead to favor separate subspecific designation of the Coloradan animal.

One reason for this designation is the fact that animals from as far apart as Mesa County, on the Gunnison River (Colorado drainage) to the west, El Paso County, on the headwaters of the Arkansas River (Mississippi drainage) to the east, and Jackson County, on the North Platte (also Mississippi drainage) to the north, have the same general combination of characters. This indicates a considerable geographic range in the more elevated, mountainous part of Colorado. Secondly, there are cranial differences of an "average" sort between *mexicanus* (from Rio Grande, opposite Mesilla

Map showing the type localities of named races of *Castor canadensis*

Park, Dona Ana County, New Mexico) and the specimens from Colorado, and in addition there is one difference by which every adult and subadult skull of topotypes of *concisor* can be distinguished from corresponding skulls from Dona Ana County. This

difference is in the size and shape of the angular process of the mandible. In topotypical *concisor* the process is long (more produced posteriorly), and sharp-pointed rather than short and posteriorly rounded.

Among the "average" differences noted between the skulls of the two lots of specimens concerned, we may mention the more nearly vertical posterior border of the postorbital process of the jugal in *concisor*. Only one of the five specimens from Dona Ana County is indistinguishable in this respect. The other four, and 18 additional skulls from several other localities lower down the Rio Grande, to as far as Brewster County, Texas, are all sharply distinct from topotypes of *concisor* in this feature. Furthermore, of *mexicanus*, it is only in this series of five skulls from Dona Ana County that we find overlap with the animals from Colorado in some other cranial characters; skulls available from any one of the places farther down the Rio Grande are uniformly separable from *concisor* on the basis of cranial features which are of only an "average grade" when specimens from Dona Ana County are employed. It seems probable to us that these more northern specimens of *mexicanus*, possibly including even animals at its nearby type locality, are in some of these minor features intergrades and therefore not typical of the race *mexicanus* as are the specimens from farther down the Rio Grande.

After *mexicanus*, the next nearest relative of *concisor* is perhaps *Castor canadensis missouriensis* Bailey. Relying on referred specimens from Cherry County, Nebraska, and Bailey's original description (Jour. Mamm., vol. 1, p. 32, 1919), *concisor* is notably darker colored (though less so than in comparison with *mexicanus*), and the skull differs as follows: Postorbital process of jugal higher; maxillary root of zygomatic arch more nearly vertical; jugal relatively straight and, posteriorly, lacking the "step" of *missouriensis;* dorsal face of rostrum more convex; nasals averaging narrower.

From *Castor canadensis frondator*, whose geographic range seems to be cut off from that of *concisor* by the ranges of *Castor canadensis repentinus* and *C. c. mexicanus*, the present race appears to differ in much darker color, relatively wider nasals, and in having the process of the alisphenoid bone to which the pterygoid muscle attaches much larger and more laterally directed. The shape of the zygomatic arch in *concisor* differs from that in *frondator* in about the same way as from *mexicanus* except that the disparity in depth of the jugal is even more pronounced (see Bailey, Proc. Biol. Soc. Washington, vol. 26, p. 192, 1913, for a comparison of *frondator* and *mexicanus*).

From *C. c. repentinus* (specimens available from the Colorado River of Nevada, California and Lower California) the Colorado beaver may readily be distinguished by its much darker color and by selected cranial features as follows: Nasals and entire rostrum wider; nasals not projecting as far behind premaxillae; jugal and entire zygomatic arch are heavier, the lateral face wider, postorbital process higher and ventral margin without, rather than with, the "step" posteriorly; outside diameter of meatal tube greater; frontal region broader.

In comparison with *taylori*, *concisor* is indistinguishable in color but cranially is distinct as described for *repentinus*. The narrowness of the dorsolateral face of the zygomatic arch is even more extreme in *taylori* than in *repentinus*. The same is true of the narrowness of the nasals.

Finally there is to be noted some slight variation among the colonies here referred to *concisor*. The one skin available from the Slate River, Gunnison County, is near (*l*) Prout's Brown above and slightly darker than the one available from Palmer Lake, El Paso County, which is near (*l*) Cinnamon-Brown. The lighter color of the last mentioned specimen provides a slight approach in color toward *missouriensis*. A somewhat nearer approach is furnished by the two skins from Boulder County. A skin from Jackson County, has even more of the color of *missouriensis*. This is true of the upperparts as well as of the underparts on which the median abdominal region is dark as in

Cranial measurements, in millimeters, of adult *Castor canadensis concisor*, of unrecorded sex, all from Colorado

CATALOG NUMBER	COLLECTION	LOCALITY	OCCIPITONASAL LENGTH	BASILAR LENGTH	ZYGOMATIC BREADTH	MASTOIDAL BREADTH	LEAST INTERORBITAL BREADTH	LENGTH OF NASALS	WIDTH OF NASALS	ALVEOLAR LENGTH OF MAXILLARY TOOTH ROW
4416	E. R. Warren	El Paso Co., Monument Creek	141.5	127.4	102.2	69.2	24.5	54.4	26.4	31.0
4255	" " "	" " " Beaver Creek	131.3	118.0	98.7	68.7	25.8	48.9	23.5	30.3
4258	" " "	" " " Monument Creek	131	119.4	96.5	61.1	25.5	46.2	23.6	31.8
3580	Univ. Colo. Mus.	Boulder Co.	—	126.5	103.5	72.1	26.0	—	—	33.7
3579	" " "	" "	133.8	114.2	93.7	66.0	24.0	48.4	24.4	32.7
1386a	" " "	" " S. Fork of Boulder Creek	128.9	115.0	90.3	62.0	24.0	46.0	22.7	29.2
1386b	" " "	Boulder Creek " " " " "	129.0	116.6	93.0	63.1	25.2	44.7	22.2	28.5
84894	Mus. Vert. Zool.	Delta Co., 7 mi. SW Cedaredge	145.2	127.2	106.7	68.4	26.0	51.1	30.5	29.5
84895	" " "	" " " " " "	134.2	127.0	104.0	66.8	25.9	50.8	29.2	31.5
84892	" " "	" " " " " "	131.8	114.7	94.3	62.2	22.2	50.0	23.1	28.8
3577	Univ. Colo. Mus.	Jefferson Co., Deckers	131.9	118.5	97.5	65.4	26.8	48.3	23.8	31.0
4256	E. R. Warren	Gunnison Co., Slate River	134.1	120.8	99.0	64.5	25.3	45.9	27.0	30.3
84568	Mus. Vert. Zool.	Jackson Co., near (within 7 mi.) Rand	137.3	123.9	100.0	69.6	25.5	48.2	24.7	22.2
84572	" " "	" "	134.9	118.3	96.1	66.6	25.0	48.8	23.6	28.9
84574	" " "	" "	129.7	114.2	95.5	63.9	25.0	46.3	23.1	28.3
84571	" " "	" "	131.3	113.5	94.2	65.7	25.4	45.6	22.9	28.6
84570	" " "	" "	125.2	112.8	94.6	64.5	24.9	46.0	22.8	29.3

typical *concisor* but with an area of lighter color lateral to this—a light color suggestive of *missouriensis*. Despite these evidences of intergradation, the general color of the skin from Jackson County definitely places the specimen with *concisor*.

In the skulls from Gunnison County, the anterolateral face of the zygomatic arch anteriorly is narrower than in the animals from El Paso County, a feature that suggests intergradation with *taylori*. In the series of skulls from Jackson County, the nasals average slightly narrower than in the other animals referred to *concisor*, but the difference is slight. The marked posterior extension, and pointed shape, of the angular process of the mandible seen in topotypes is not generally found in the other populations assigned to *concisor*. Except for the slight variations just mentioned, the skulls here assigned to *concisor* impress us as remarkably uniform over a large geographic area. They are easily distinguished from those seen of every other named race except *mexicanus*. It is only the more northerly colonies of *mexicanus* whose skulls sometimes closely resemble those of *concisor*.

Specimens examined.—Total number, 47, all from Colorado (unless otherwise indicated, skulls only) as follows: *Jackson County:* Coalmont, 1 (Univ. Colo. Mus.); near (within 7 miles of) Rand, 24 (one skin with skull) (Mus. Vert. Zool.). *Boulder County* (Univ. Colo. Mus.): No locality more definite than county, 3; South Fork of Boulder Creek, 2 (skins with skulls). *Mesa County:* Gunnison River, 4750 ft., about 29 mi. NW Delta, 3 (one skin with skull) (Mus. Vert. Zool.). *Delta County:* Dry Creek, 5300 ft., 7 mi. SW Cedaredge, 4 (Mus. Vert. Zool.). *Jefferson County:* Deckers, 1 (Univ. Colo. Mus.). *Gunnison County:* Slate River, near Crested Butte, 3 (E. R. Warren coll., one a skin with skull). *El Paso County:* Palmer Lake, 1 (skull with skin, Colo. College Mus.); Monument Creek, 3 (2 with partial skeletons and one of these, the type, in Mus. Vert. Zool.; the other two in E. R. Warren coll.); Lake Moraine, 10250 ft., 1 (E. R. Warren coll.); Beaver Creek, Waldron Ranch, 1 (E. R. Warren coll.).

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DESCRIPTIONS OF FIVE NEW MAMMALS FROM FLORIDA

By Arthur H. Howell

Recent studies of Florida mammals have resulted in the discovery of a number of forms that appear to be new. These are here described.

Scalopus aquaticus bassi, subsp. nov.

South Florida Mole

Type.—Collected at Englewood, Sarasota County, Florida, November 4, 1935, by Stewart Springer; ♀ adult, skin and skull, No. 43968, Field Museum of Natural History; original number 15.

Range.—Known only from the type locality.

External characters.—Smallest known form of the genus; similar to *S. a. parvus*, from Tarpon Springs, but smaller and slightly more grayish, lacking the golden sheen on the back shown by *parvus*.

Cranial characters.—Skull smaller than that of *parvus*, with narrower and shallower braincase, and shorter and relatively broader rostrum.

Color.—Upper parts fuscous with a grayish sheen; under parts similar, sometimes tinged with a wash of clay color; borders of nose and bases of front feet sometimes with a wash of ochraceous-tawny.

Measurements.—Type (♀ adult): Total length, 115 mm.; tail vertebrae, 17; hind foot, 15. Average of 3 males from type locality: 111.7 (105–115); 17 (16–18); 15.7 (15–16). *Skull* (type): Greatest length, 26.8; mastoid breadth, 13.6; interorbital breadth, 6.3.

Remarks.—These little moles were living at Englewood in gardens or lawns, their tunnels sometimes extending almost to the edge of the shore of Lemon Bay. In heavy turf they often throw up little mounds of earth 2 or 3 inches high at frequent intervals along their runways—a habit that is unusual in members of this genus.

This race is named in honor of Mr. John Bass, Jr., proprietor of the Bass Biological Laboratory at Englewood, Florida. All the specimens known, save one, were captured by Mr. Stewart Springer, biologist at the Laboratory.

Specimens examined.—Five, from the type locality (4 in Field Museum, 1 in Biological Survey collection, U. S. National Museum).

Peromyscus polionotus decoloratus, subsp. nov.

Pallid Beach Mouse

Type.—Collected at Ponce Park, near Mosquito Inlet, Florida, May 25, 1925, by Arthur H. Howell; skin and skull, No. 245780, U. S. Nat. Mus. (Biological Survey collection); original number 2448.

Range.—Known only from the type locality and from Bulow; probably occurs from Mosquito Inlet north to Matanzas Inlet.

External characters.—Similar to *P. p. phasma*, of Anastasia Island, but colors paler; head a little paler than back, but not distinctly white as in *phasma;* smaller and much paler than *niveiventris*.

Cranial characters.—Skull about the size of that of *phasma* or slightly longer; rostrum slightly broader at tip (*phasma* is slightly broader at the base and the rostrum tapers more toward the tip); smaller than that of *niveiventris*.

Color.—Head and upper parts pale pinkish buff, slightly darkened with wood brown on the back; paler on the head but not actually white; under parts and sides of head

pure white; feet and tail thinly clothed with whitish hairs; ears hair brown on outer surface.

Measurements.—Average of 8 adults from type locality: Total length, 135.5 (130–142); tail vertebrae, 52.4 (50–55); hind foot, 18.4 (18–19.5). *Skull:* Average of 6 adults: Greatest length, 23.3 (23–23.9); zygomatic breadth, 12 (11.5–12.4); interorbital breadth, 3.9 (3.7–4); length of nasals, 9.3 (9.1–9.5); maxillary tooth row, 3.4 (3.3–3.5).

Remarks.—This is the palest of the three races of beach mice occurring on the east coast of Florida. It is about as pale as *P. p. leucocephalus*, of Santa Rosa Island, but lacks the white head, and the dark area of the back is broader. It is abundant on the ocean beach at Ponce Park, living, like the other beach mice, on the sand dunes near the ocean. Two specimens were taken at Bulow, but not saved.

Specimens examined.—13, from the type locality.

Peromyscus polionotus peninsularis, subsp. nov.

St. Andrews Beach Mouse

Type.—Collected on St. Andrews Point Peninsula, Bay County, Florida, April 24, 1938, by David G. Nichols; ♀ adult, No. 131489, Amer. Mus. Nat. Hist.; original number 1227.

Range.—Known only from the type locality and from Cape San Blas, Florida.

External characters.—Similar to *P. polionotus leucocephalus*, of Santa Rosa Island, but back and ears averaging much darker (more brownish).

Cranial characters.—Skull similar to that of *leucocephalus* but averaging shorter.

Color.—Dorsal area, from crown to rump, wood brown; ears hair brown; head, face, sides, under parts, feet, and tail pure white.

Measurements.—Average of 10 adults from type locality: Total length, 126.4 (119–140); tail vertebrae, 49.1 (45–55); hind foot, 18.2 (17–20); ear, 16 (14–17). Weight, 14 grams (11.5–16.8). *Skull.*—Average of 6 adults from type locality: Greatest length, 22.9 (22.5–23.4); zygomatic breadth, 12.5 (12.2–13); interorbital breadth, 3.8 (3.7–3.9); length of nasals, 9.2 (8.8–9.7); maxillary tooth row, 3.3 (3.3–3.4).

Remarks.—The series on which this new form is based was taken by David G. Nichols and other members of an expedition sent out by the American Museum of Natural History. This race, although living on a small peninsula connected with the mainland, is widely different from the mainland form (*albifrons*), which occurs only a few miles to the northward; but under the environment of the ocean beaches it has developed a pure white head and sides, similar to *leucocephalus* of Santa Rosa Island to the westward, but with a much darker back.

Specimens examined.—Total number, 21, as follows:

Florida: St. Andrews Point Peninsula, 13; Cape San Blas, 8 (all in American Museum of Natural History, New York).

Peromyscus gossypinus restrictus, subsp. nov.

Chadwick Cotton Mouse

Type.—Collected on Chadwick Beach, near Englewood, Florida, March 13, 1938, by Luther C. Goldman; ♀ adult, skin and skull, No. 263539, U. S. Nat. Mus. (Biological Survey collection); original number 479.

Range.—Known only from the type locality.

External characters.—Smaller and paler than *P. gossypinus palmarius* of the mainland of Florida, with the dark median dorsal area reduced to a minimum. Compared with *P. g. anastasae*, of Anastasia Island, the sides are more pinkish and they lack the cinnamon-buff of the latter; also, *restrictus* is not conspicuously darkened in the middle of the back as is *anastasae*.

Cranial characters.—Skull essentially similar to that of *palmarius*.

Color.—Adult (type): Upper parts and sides nearly uniform light pinkish cinnamon, slightly darkened with fuscous, especially on the middle of the back; ears and upper surface of tail hair brown; under side of tail "tilleul-buff"; under parts white, with a wash of pale pinkish buff on the chest, the bases of the hairs neutral gray. Another adult is darker—near pinkish cinnamon, mixed with fuscous.

Variation.—There is considerable variation in the series; young in first pelage are uniform neutral gray (paler than the young of *palmarius*); at a later stage they take on a wash of pinkish buff; one very old adult is nearly uniform "sayal brown", with a wash of gray on top of the head.

Measurements.—Average of 7 adults from type locality: Total length, 172 (164–187); tail vertebrae, 72.5 (68–83); hind foot, 22.3 (22–23); ear from notch, 15.2 (15–16). *Skull.*—Average of 5 adults from type locality: Greatest length, 27.6 (27.3–28.1); zygomatic breadth, 13.9 (13.4–14.9); interorbital breadth, 4.4 (4.3–4.5); length of nasals, 10.9 (10.5–11.3); maxillary tooth row, 3.9 (3.7–4).

Remarks.—The 15 specimens taken on Chadwick Beach were observed in the field to be noticeably paler than the mice of the adjacent mainland. They were trapped among the sea oats on the Gulf beach, where we found numerous tracks and trails, and also in the adjacent cabbage palm jungle.

Sylvilagus floridanus ammophilus, subsp. nov.

Beach Cottontail

Type.—Collected at "Oak Lodge," on peninsula opposite Micco, Florida, January 22, 1895, by J. Alden Loring; ♂ adult, skin and skull, No. 70313, U. S. Nat. Mus. (Biological Survey collection); original number 2672.

Range.—Known only from the type locality.

External characters.—Similar in size to *Sylvilagus floridanus floridanus*, of the Florida mainland, but color of upper parts, sides, head, and ears paler (less blackish); nape patch a paler shade of tawny. Compared to *S. f. mallurus:* Size smaller; head, upper parts, and sides paler (less tawny).

Cranial characters.—Skull similar to that of *floridanus*; auditory bullae averaging smaller; much smaller in all dimensions than that of *mallurus*, especially in breadth of rostrum at base; bullae much smaller.

Color.—Type, winter pelage: Head and upper parts light pinkish cinnamon, shaded with bister; nape patch pinkish cinnamon; sides "tilleul buff" (of Ridgway), mixed with grayish white; rump grayish white; legs light pinkish cinnamon, shading to white on the toes; under parts white, except for the throat patch, which is vinaceous buff.

Measurements.—Average of 8 from the type locality: Total length, 419 (377–451); tail vertebrae, 57 (42–69); hind foot, 92.2 (81–97); ear, 61 (58–66). *Skull.*—Average of 7 adults from type locality: Greatest length, 71.3 (69–74.7); basilar length, 55.3 (54–57); parietal breadth, 25.6 (24.1–26.8); zygomatic breadth, 34.7 (34–35.3); length of nasals, 30.2 (28.4–31); maxillary tooth row, 13.8 (13.4–14.2).

Remarks.—Bangs (Proc. Boston Soc. Nat. Hist., vol. 28, 1898, p. 174) referred the cottontails from Oak Lodge to *Lepus sylvaticus sylvaticus* (= *Sylvilagus floridanus mallurus*), he evidently having failed to notice the wide difference between the skulls of this form and those of *mallurus*, although he was correct in separating them from typical *floridanus* of the Florida mainland. Nelson (1909, p. 165) referred this form to *floridanus* without comment.

As pointed out above, it differs in color from *floridanus* and in size from *mallurus*. The limits of range of this race are not known.

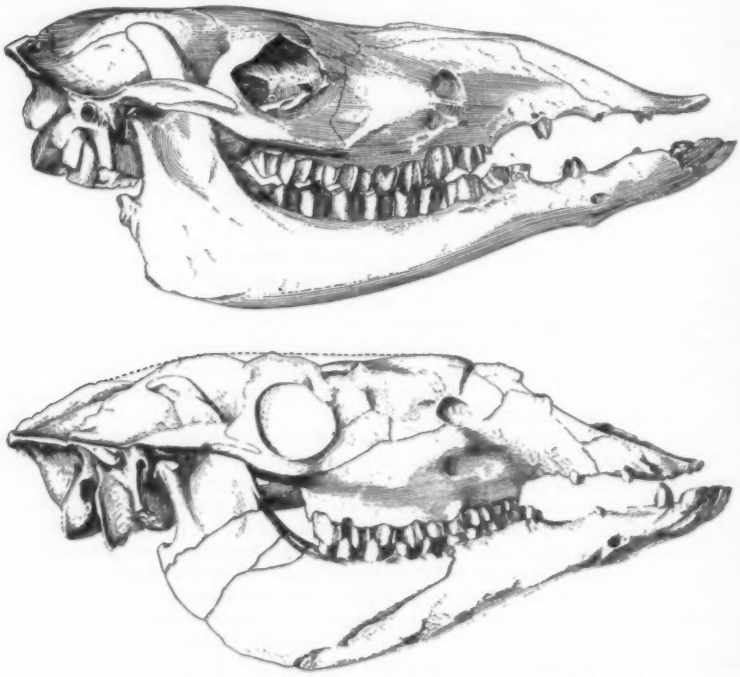
Specimens examined.—8, from the type locality.

Bureau of Biological Survey, U. S. Department of Interior, Washington, D. C.

TWO NEW CAMELS FROM THE LATE LOWER PLIOCENE OF SOUTH DAKOTA

By Joseph T. Gregory

I herewith place on record preliminary diagnoses of two new species of camels from the late Lower Pliocene fauna of Big Spring Canyon, South Dakota. Detailed descriptions and comparisons, with additional figures,



Upper. *Pliauchenia magnifontis* n. sp. Lateral view of skull and lower jaws of type, $\frac{5}{16}$ natural size. Drawing by Owen J. Poe.

Lower. *Procamelus grandis* n. sp. Lateral view of skull and lower jaws of type, $\frac{3}{16}$ natural size. Drawing by Owen J. Poe.

will appear in a faunal report. The specimen described below as *Pliauchenia magnifontis* n. sp., shows that the second premolar was absent in both upper and lower jaws in this genus. Therefore the dental formula of *Pliauchenia* should read: premolars $\frac{3}{3}$, instead of $P\frac{4}{3}$, as originally stated by Cope.

Pliauchenia magnifontis new species

Types.—Holotype, a slightly crushed skull, lower jaws, limb bones, and some vertebrae of a young adult. Univ. Calif. Mus. Pal. No. 32106. Paratype, broken skull of an old individual, U.C.M.P. No. 33014.

Type locality.—Big Spring Canyon, U.C.M.P. Loc. V3322, is on the Ed Ross Ranch (under the name of Roy S. Ross), ten miles west and four miles south of Martin, Bennett County, South Dakota. The canyon lies in the eastern side of sections 5 and 8, T. 36 N., R. 39 W.

Diagnosis.—Intermediate in size between *Pliauchenia humphreysiana* and Middle Pliocene species referable to the genus; jaw about the size of *Procamelus occidentalis*. Vestigial Dp $\frac{2}{2}$ retained in type specimen; $P\frac{2}{2}$ absent in paratype. Caniniform teeth well developed, single-rooted, narrow, trenchant, not massive, curved backward. P^2 elongate but moderately wide, unreduced. P_2 narrow, elongate. $P\frac{4}{4}$ and molars cameloid, of same proportions and height of crown as in *Procamelus*. Palate not constricted in front of P^2, flaring slightly at anterior ends of maxillaries. Muzzle narrow, tapering. Ramus of jaw elongate and heavy but not deep. Metapodials fused, of about the same proportions as *Procamelus* or slightly more slender. Smaller than the contemporary species of that genus.

P. magnifontis is larger than the type of *P. humphreysiana*. Due to the poor preservation of the latter, comparisons are difficult to make. *P. singularis* is smaller than *P. humphreysiana* and has smaller premolars than other species of the genus. The remaining described species cannot be included properly in *Pliauchenia: P. spatula* and *P. gigas* belong to *Megatylopus*, *P. vulcanorum* to *Procamelus*, and *P. vera* to *Tanupolama*. *P. minima* is a peculiar jaw with narrow, high-crowned teeth and exceedingly narrow, straight premolars. It shares the appearance of antelopes and camelids, and does not pertain to *Pliauchenia*, whatever its affinities may be.

Measurements of *Pliauchenia magnifontis* (in millimeters)

	U.C.M.P. 32106	U.C.M.P. 33014
Length skull, tip premaxillary to condyles	345	340
Width skull at postorbital processes	154	150
Width palate between canine alveoli	24	23
Diastema between I^3–C	15	18
Diastema between C–P^1	19	11
Diastema between P^1–P^3	28	32
P^2–M^3 inclusive	120	89
Lower jaw, tip incisors-angle	305	
Diastema between C–P_1	21	
Diastema between P_1–P_3	31	
P_2–M_3 inclusive	128 (approximate)	

The radioulnae are 370 mm. from lower edge of sigmoid notch to distal end; metacarpals 300 and 303 mm. long and 26 mm. wide at center; tibia 390 mm. long; metatarsal 287 mm.

Procamelus grandis new species

Types.—Holotype, skull and lower jaws, U.C.M.P. No. 32864. Paratypes, skull, lower jaws, and associated skeletal elements. These specimens came from the same site in the canyon as the type. Some of the skeletal elements may belong to the type and

some to the paratype skull, U.C.M.P. No. 32301. Left ramus and symphysis of jaw, U.C.M.P. No. 32589; Rostrum of skull with left P^1 and right P^2 — M^1, U.C.M.P. No. 33449. The last two specimens agree so well in size, amount of wear on teeth, and state of preservation, that I believe they belong to the same individual, although they were separated in the deposit. Considerable additional material is referred to this species, and will be mentioned in describing the skeleton in the faunal report.

Type locality.—Big Spring Canyon, South Dakota.

Diagnosis.—Large species of *Procamelus* with rather slender, compressed, blade-like caniniform teeth and thin anterior premolars. Considerably larger than *P. occidentalis*. Diastemata between caniniform teeth of variable length, but uniformly greater than in *Alticamelus*, approaching the condition in referred material of *P. occidentalis*. $P\frac{1}{1}$ single rooted. Inner crescent of P^3 incomplete, usually greatly reduced. Cheek teeth high crowned. Lower incisors protruding. A well developed sagittal crest and broad occipital crest. Neck vertebrae not elongate. Limb bones stout, not elongate.

This species is considerably larger than *Procamelus occidentalis*, to which it appears to be most closely related. *P. robustus*, *P. elrodi*, *P. madisonius* have heavier caniniform teeth separated by shorter diastemata, and wider premolars than *P. grandis*. *P. lacustris*, which does not differ importantly from *P. occidentalis*, and the small species *P. gracilis*, *P. concerptus*, *P. benidentatus*, *P. leptognathus*, and *P. coartatus* are all considerably smaller than the new species. Those which are adequately known may be separated by other characters than size: *P. coartatus* by its constricted rostrum and round, llama-like caniniform teeth; *P. leptognathus* by its low-crowned molars and complete inner crescent on P^3. *P. inaequidens* is slightly smaller than the new species, and differs in the double rooted P^1. *P. edenensis* and *P. edenensis raki* are indeterminate forms, not demonstrably *Procamelus*. *P. minor*, *P. major*, and *P. minimus* are not known from sufficient material to make adequate comparisons.

Measurements of *Procamelus grandis* (in millimeters)

	U.C.M.P. 32864	U.C.M.P. 32301	U.C.M.P. 33449
Length skull, tip premaxillaries to condyles	420	390	—
Breadth skull across postorbital processes	175	150	—
Diastema between I^3–C	13	14	18
Diastema between C–P^1	27	25	19
Diastema between P^1–P^2	41	21	31
P^2–P^4, inclusive	38	42	43
M^1–M^3, inclusive	100	98	—
			U.C.M.P. 32589
Lower jaw, tip incisors to angular process	387	342	360
Diastema between C–P_1	34	19	26
Diastema between P_1–P_2	37	29	29
P_2–M_3, inclusive	146	144	144

Lengths of 4 radio-ulnae, measured from the distal end of the sigmoid notch, are 425, 430, 465, and 480 mm. Two metacarpals are 385 and 388 mm. long; the tibiae are 430 to 480 mm. long; the metatarsals 325 to 374 mm.

Museum of Vertebrate Paleontology, University of California, Berkeley, California

GENERAL NOTES

NOTE ON THE LECTOTYPE OF LASIURUS SEMOTUS (H. ALLEN)

When Harrison Allen described the Hawaiian hoary bat in 1890 (Proc. U. S. National Museum, vol. 13, pp. 173–175, September 9, 1890) he based his account of the new species *"Atalpha" semota* on eight specimens in the U. S. National Museum, but neglected to designate a type. Of the only specimen preserved in alcohol (no. 15631) he printed a table of measurements (p. 174). This specimen was formally made the lectotype by Lyon and Osgood in 1909 (Bull. U. S. National Museum, no. 62, p. 277). Having recently had occasion to examine the lectotype and remove its skull I have found that the original description contains a serious error that needs to be corrected, and some omissions that need to be filled.

The error is the measurement of "40 mm." instead of 50 mm. for the forearm (table, page 174). This makes the animal appear to belong to the *Lasiurus borealis* group though, in reality, its relationship is entirely with the hoary bats, *Lasiurus cinereus, L. grayi*, etc.

The National Museum now contains 11 specimens of *Lasiurus semotus:* the original series, 6 (all red) collected by Valdemar Knudsen on Kauai, 3 (all gray) taken by H. W. Henshaw on Hawaii, another, (red) from the same island collected by C. N. Spencer, and one (red) skin without history. This material shows that the Hawaiian bat, unlike *Lasiurus cinereus*, has two well defined color phases like those of *Lasiurus borealis*.

In its gray phase *Lasiurus semotus* differs inconspicuously from the North American *L. cinereus* (no. 98148 from Hilo, Hawaii, for instance, nearly resembles *cinereus* no. 4728 from South Carolina). The dorsal surface of the interfemoral membrane in the Hawaiian bat tends to be darker than in *L. cinereus*, and the buff of the throat, sides of body beneath the wing membranes, and the hairy areas on the underside of the membranes behind the forearms is noticeably less tinged with yellow.

In its red phase *Lasiurus semotus* is unlike any specimen of *L. cinereus* that I have seen. The red is probably never as bright as in the brightest skins of *L. borealis;* but between some individuals of the two species (for instance *semotus* 15630 from Kauai and *borealis* 122633 from Washington, D. C.) there is no essential difference.

Cranial and dental characters are like those of *Lasiurus cinereus*, but size of skull averages slightly less than in the continental animal. The greatest length in six Hawaiian skulls ranges from 15.6 to about 17 mm. (occiput imperfect) as compared with 16 to 18 mm. in six skulls of *L. cinereus* taken at random.

The forearms of six Hawaiian specimens range from 48 mm. to 53 mm. as compared with 50 mm. to 57 mm. in a like number of skins of the continental hoary bat.—GERRIT S. MILLER, JR., *U. S. National Museum, Washington, D. C.*

NOTES ON THE SEX RATIO IN NYCTICEIUS HUMERALIS

A series, totaling 148 individuals, of *Nycticeius humeralis* at hand is sufficiently large to supply data of value on the sex ratio in the species. The entire series, now preserved in alcohol, was obtained by F. S. Barkalow, Jr., on May 24, 1938, in the attic of a house in Auburn, Lee County, Alabama. All bats were collected that could be secured, that is to say, no selection was made for either age or sex. Most of the animals were captured as they hung on a wall or were lodged in crevices. Many young, however, were secured from the floor of the attic where they had been dropped by the females. The young animals are all young of the year. They range in measurement of total length from about 40 mm. to about 50 mm. and in length of radius from about 12.5 mm. to 23.0 mm. The large females measure about 83 mm. in total length and 38 mm. in length of radius. Of the 148 specimens, 56 are adult breeding females, 39 young females and 53 young

males. No adult males were obtained from the colony. The sex of each animal was determined from examination of the external genitalia. As computed from these figures the ratio of young females to young males is .736 to 1.00. This is a remarkably high discrepancy of sexes, considering the numbers of individuals at hand and the random sampling employed in obtaining them.—EMMET T. HOOPER, *Museum of Zoology, Ann Arbor, Michigan.*

THE LECONTE FREE-TAILED BAT IN ALABAMA

A. H. Howell (North Amer. Fauna no. 45, 1921 pp. 28–29) gives only two locality records in Alabama for the occurrence of the free-tailed bat, *Tadarida cynocephala* (Le Conte). Dr. W. C. Avery took about four hundred specimens from an old house in Greensboro, Hale County, on July 31 and August 1, 1890; and two specimens were shot by hunters at Orange Beach, Baldwin County on January 24 and 28, 1912. I believe that no specimens of this species have been reported from Alabama since the latter date. On May 20, 1938, Duncan McIntosh and I collected an adult male *Tadarida cynocephala*, together with 10 *Eptesicus fuscus fuscus* (Beauvois), hanging in a crevice between the walls of a brick building on the Alabama Polytechnic Institute campus, Auburn, Lee County, Alabama. The *Tadarida* had a large fistula, similar to those caused by bot fly larvae, on the midventral portion of its neck. Of the ten *Eptesicus*, seven were young unable to fly, two were adult females suckling young, and a third adult escaped before its sex could be determined.—FRED S. BARKALOW, JR., *Department of Zoology-Entomology, Alabama Polytechnic Institute, Auburn, Alabama.*

NOTES ON AN OTTER FISHING

While at the Banks deer checking station on the south Fork of the Payette river, 42 miles north of Boise, Idaho, the latter part of October 1938, I observed an otter in the act of fishing. The animal came directly up stream into the still water above the highway bridge. It crawled out on a rock about six inches above the water and stayed there for perhaps one minute, looking intently into the water, about 8 feet deep. It slid off into the water and came up immediately with a 10-inch squaw fish in its mouth. This fish was eaten in nine minutes, much as a cat eats a piece of meat. The otter used first one side of its jaws and then the other, consuming the entire fish with the exception of the tail.

On finishing this fish the otter lay down and rubbed the sides of its head upon the rock, apparently to clean its face and whiskers. At no time did it use its fore paws to clean itself.

After cleaning itself for 10 minutes the otter again slid into the water after another fish. This time it dived and came up repeatedly for about 7 minutes before it brought up another squaw fish of the same size as the first. This fish was caught about the middle of the stream and carried to the opposite bank, then consumed in the same manner as the first one in about the same length of time. On reaching the rocks the fish escaped and "skittered" over the water toward midstream. The otter flipped itself over backward and caught the fish while still on its back.

After consuming the second fish the animal spend several minutes cleaning itself, then it again started fishing. This time it caught nothing. Fifteen minutes later it swam away downstream under water.

The animal's body was about twenty-four inches long with a tail length of about eighteen inches. It was very dark brown, almost black, with grey along the cheeks and down between the front legs and posterior portion of the belly.

This river contains trout, squaw fish and suckers, with the squaw fish predominating. It is reasonable to suppose that the easiest available fish was taken. Three otters have

been reported on this stretch of the South Fork of Payette River.—LAURENCE H. SMITH, *McMinnville, Oregon.*

SWIMMING POWER OF THE CANADIAN OTTER

Conservation Warden Ben Waskow, Bayfield, Wisconsin, recently reported that on February 24, 1939, Ben Gustavson, a commercial fisherman, also of Bayfield, pulled up a set line from 42 feet of water and 500 feet from the shore of Bass Island, Apostle Islands, Lake Superior, to find an otter (*Lutra canadensis*) on one of the hooks. The bait was missing from several hooks, and the otter must have been caught on a hook while taking the bait or a larger fish. The otter had been drowned in its efforts to release itself.

This fishing is done through holes in the ice which covers the island waters during this season. Although the swimming powers of the otter are well known, this definite record of depth and distance traveled under ice is unusual.—W. E. SCOTT, *Wisconsin Conservation Department, Madison, Wisconsin.*

SEA OTTERS AND ABALONES

Edna Fisher, in her article, "Habits of the Southern Sea Otter," in the February (1939) number of this Journal writes that, "It is still unknown just how the otter detaches the large abalones from the rocks with their small paws." In regard to this statement the following may be of interest. Abalones, when alarmed, cling so tenaciously to their substratum that they can be dislodged only by violent prying with an iron bar. However, when undisturbed, their grip on the rock is relatively loose and a man often can easily remove them by a sudden jerk of his hand or a sharp blow. In view of these facts, one suspects that the otters hunt by catching the edges of an abalone's shell with their paws and then quickly tearing the animal loose before it can clamp down.—JOHN E. CUSHING, JR., *San Francisco, Calif.*

COYOTES PREY ON GOATS

During the discussion that followed Mr. Charles Sperry's paper on "Food Habits of Peg-Legged Coyotes," at the 1938 annual meeting of the American Society of Mammalogists, doubt was expressed that the "well known fact" that coyotes prey upon domestic stock was actually a fact. The idea was advanced that the domestic animal material found in coyote stomachs could quite possibly be carrion. Study of the food habits of the coyote in southeastern Santa Cruz County, California, has brought to light the following concerning the preying of coyotes on goats:

Checking the ranchers against each other has corroborated statements of happenings before the study started. There are three ranchers in the district that have been losing goats over a period of two years. One rancher lost 76 goats, another 55, and a third, 317. The depredations began rather suddenly, approximately two years ago. Believing that the animals were being stolen, one rancher started a daily check-up. Having only 90 goats in a fenced area, daily surveillance was an easy matter. When another goat disappeared a search for human footprints uncovered a dead, partly eaten animal surrounded by coyote tracks. From this time to the present, goats have been killed, occasionally as many as four in a night. Questioned as to the possibility that the animals were sick, the rancher said close observation does not show sickness, nor has any disease been going around. The possibility that some other animal has done the killing was ruled out because only coyote tracks are found around the carcasses; and the dogs, when put on the scent, raise only coyotes. When the individual coyotes are tracked down and killed, the trouble stops until another coyote starts work. Twice, in broad daylight, coyotes have been seen to attack the goats. The bark and "drive" of the coyote have been heard and a dead goat found later near the herd. Two different

farmers tell of finding goats still alive with the udder and stomach eaten away, and the animal surrounded by coyote tracks. This seems rather conclusive. In accord with Mr. Sperry's findings, the ranchers volunteer the information that the main offender is a large coyote with a crippled front leg, which has never been caught. The animal has been seen several times, and its tracks, recognizable by the crippled foot, have been noted around a number of carcasses. It is trap shy, never returning to a carcass once left, but kills anew each time.

The fact that the local coyotes at least will not attack a belled animal has offered a solution to the ranchers which they are beginning to adopt. Whether the sound of the bell or the heavy leather strap shielding the throat protects the animal is not known.—ALBERT C. HAWBECKER, *Watsonville, California.*

DENTAL ANOMALY IN AN ESKIMO DOG

I desire to record the presence in the skull of an eskimo dog from West Greenland (no. 29801 Mus. Comp. Zool.), of a *third upper molar* on the right-hand side. The tooth (fig. xi) is normal in appearance and position, with a crown area of about a third that

Eskimo Dog with Third Upper Molar

of the second molar, and is separated from the latter by about one millimeter. In outline the crown is almost a smaller replica of the one in front of it, with however, only three small cusps evident. These are: on the outer border a large paracone and a much smaller metacone; and on the inner border a lower cone apparently corresponding to a protocone. This is the only case I have come upon in a great number of dog skulls, of a third upper molar, and it is no doubt a "reversion" to the primitive condition in which three must have been the normal number. A case of a dog skull with four upper incisors, three premolars, and three molars on one side has been reported by Kunstler and Chaine (Proc. Verb. Soc. Sci. Phys. et. Nat., Bordeaux, 1905-06, p. 26).—GLOVER M. ALLEN, *Museum Comparative Zoology, Cambridge, Mass.*

A WEASEL TRAILS A RABBIT

It has never seemed possible to me that a weasel could ever actually run down a rabbit. However, on January 17, 1939, I observed an interesting drama. The incident occurred about two miles from Mountain Lake in Giles County, Virginia, at an elevation of approximately 3500 feet. It was about 11:30, with the sun shining brightly, and eight to fourteen inches of snow on the ground. A rabbit (*Sylvilagus sp.*) came struggling down the steep mountainside through the deep snow drifts to the road in front of the car. A few feet behind, using the rabbit's tracks except when a short cut was possible, followed an exceptionally large weasel (*Mustela frenata noveboracensis*). Both passed my car, crossed the road, and disappeared over the mountainside. I grabbed my gun

and loaded it as quickly as possible, and hurried to the side of the road. Both animals had progressed part way down the other slope, but the rabbit had started to come back and was nearly at the road when I got to the edge. Their speed in the deep snow was comparatively slow. The weasel was a foot or so closer and seemed in no hurry to catch the rabbit. I am sure the weasel saw me but nevertheless he continued the pursuit. On the road the weasel gained somewhat and was only a foot and a half behind the rabbit when I shot him. At the explosion of the gun the rabbit stood fixed in its tracks, and when I approached, showed no signs of retreat and permitted me to stroke and pet him before he departed slowly.

I followed the two tracks back for about half a mile. Here the weasel's trail met that of the rabbit.—Edward Addy, *Department of Biology, Virginia Polytechnic Institute, Blacksburg, Virginia.*

BADGERS IN NORTHEASTERN MISSOURI AND SOUTHEASTERN IOWA

There are in our files no records of badgers in Missouri since 1926, when one animal was taken in Johnson County. Therefore the appearance of a 20-pound male in Clark County, northeastern Missouri, is of more than ordinary interest. The animal was captured in a wolf trap on December 27, 1938, by Eugene J. Bennett of Alexandria, Missouri. The location was in Des Moines Township, four miles northeast of Wayland on the levee along the Des Moines River. It was seen and identified by Kenneth R. Hicks, State Conservation Agent, and L. S. Hopkins, Dean and Professor of Biology, Culver-Stockton College; it was mounted by Ward Gregory of Kahoka, Missouri, and is now in Mr. Bennett's possession.

About a week earlier, the Gate City News of Keokuk, Iowa, reported the capture of another badger on the Iowa side of the Des Moines River near Keokuk, but we have been unable to learn the details of its capture.

This information was received from Messrs. Bennett and Hicks.—Rudolf Bennitt, *Department of Zoology, University of Missouri, Columbia, Missouri*

CLIMBING ABILITY OF THE NORTHEASTERN CHIPMUNK

At Center Ossipee, New Hampshire, an instance of a chipmunk's walking along a clothesline was reported to me by a local resident. The animal was seen to climb an apple tree, walk along the rope to a burlap sack from which it would strip off and stuff in its pouches a bunch of fibers and then return to the ground. Chipmunks which I have observed are rather cautious in their behavior while climbing in trees and any movements, especially the crossing from one branch to another, are done with utmost caution.

In view of this experience, I did not give credence to the rope walking report. A year or two later, however, I saw a motion picture of a chipmunk walking along a stretched rope and standing on its hind legs to obtain a peanut which hung suspended over its head.

Various authors have commented on the climbing ability of the chipmunk. F. E. Wood (Bull. Ill. State Lab. Nat. Hist., vol. 8, pp. 521–524) refers to the ease with which Illinois chipmunks climb trees, in contrast with the less ability of New England animals. Evidently there is much individual variation in the climbing habit.—Norman A. Preble, *Chesterville, Ohio.*

OBSERVATIONS ON RED SQUIRREL TRAVEL IN TREADWHEEL

Early in the fall in 1935 I trapped one of the red squirrels (*Tamiasciurus hudsonicus*) so common in the woods near Park River, North Dakota. It was a male squirrel of not less than one and a half years in age; at first it bit and slapped with its front paws

with amazing rapidity, but in a surprisingly short time it accepted its captor as a friend.

Within a short time after capture the animal, christened "Philbert", had become accustomed to its wire enclosed cage with a hollow section of a small tree trunk in one end and a treadwheel in the other. During the day Philbert slept in a hollow log hidden by cotton waste pulled over his head. At night he would come out and run in the wheel, always toward the street light that shone through the window. If the cage was reversed end-for-end he would jump out of the wheel, then enter it again and continue his running toward the light. When driven out of his nest during the day or on occasions when no one was around he would exercise in the wheel, but always running toward the light; probably feeling that he would eventually escape from his cage and reach safety among the trees in the distance.

The night watchman who remained in the building during the night reported such unusual activity from Philbert that it was decided to see how far he traveled each day. Since the wheel in his cage was exactly one half the size of a standard bicycle wheel, it was not difficult to attach a speedometer and calculate the distance traveled, one half of the daily reading of the speedometer being the distance traveled in miles.

During the brief period when definite records were kept of Philbert's activities he ran 240 miles, the farthest in 24 hours being 23 miles. Unfortunately no record was kept of the difference in night and day distances traveled.

Philbert's travel at night was governed somewhat by the presence or absence of the night watchman in the section of the building in which he was kept. This was especially true if more light reached him than that which normally came through the window. The cause of his record low of 4 miles traveled on the tenth day of the period was not determined.

Philbert lived two years and seven months in his cage with no apparent diminishing vigor until a few days before his death, which apparently was caused by lead poisoning from freshly dried paint he gnawed off the walls of his cage.—ADRIAN C. FOX, *Park River, North Dakota.*

OCCURRENCE OF THE BUSHY-TAILED WOODRAT (NEOTOMA CINEREA) AT FRESNO, CALIFORNIA

In recent years the accidental or deliberate transportation of wild animals into areas where they do not normally occur has become commonplace, particularly with regard to animals which serve as game or as pets. Woodrats do not ordinarily fall within these categories, and for this reason the occurrence of the bushy-tailed woodrat at Fresno, California, is interesting.

The animal was first seen on May 7, 1937, by Mr. C. E. Gage, caretaker of the Holy Cross Cemetery, as it ran out from beneath an automobile which was passing the cemetery. Mr. Gage was not sure whether the animal was merely crossing the road at the time the automobile passed or whether it fell from this automobile. The animal was so tame that Mr. Gage nearly succeeded in picking it up. Because he thought it was a chinchilla which had escaped from captivity, he herded it into a shed and then called the Roeding Park Zoo to come for it. Mr. Don Piening responded to the call and caught the animal, which he recognized as a woodrat. It was kept alive at the zoo for two weeks by Mr. A. A. Boyer, zoo superintendent. On May 21 it died and was then prepared as a scientific specimen (no. 39 Douglass H. Hubbard.) The following year the specimen was given to the Museum of Vertebrate Zoology where it is now no. 84243. It was identified as *Neotoma cinerea cinerea* by Dr. Seth B. Benson.

In California at the latitude of Fresno this race of bushy-tailed woodrats ordinarily inhabits the Hudsonian and Canadian life-zones in the Sierra Nevada and is not known

to occur below an elevation of about 5000 feet. Its occurrence on the outskirts of Fresno in the Sonoran life-zone at an elevation of only 300 feet and about seventy miles from the nearest locality which it normally occurs is therefore distinctly out of the ordinary. Although it is possible that the woodrat came to Fresno from the Sierra Nevada on its own initiative, it seems more probable that it may have been brought down from the mountains in a load of wood, or that it is the escaped pet of someone who brought it to Fresno from some distant place.—DOUGLASS H. HUBBARD, *2010 Channing Way, Berkeley, California.*

A SWIMMING AND DIVING MEADOW VOLE

As Irving J. Cantrall and I were walking along the edge of a woods-bordered swamp on the Edwin S. George Reserve, Livingston County, Michigan, at about 4 p.m. on April 25, 1939, we observed an adult male meadow vole (*Microtus pennsylvanicus pennsylvanicus*) enter the water and appear quite at home there. The vole was first seen by Cantrall in front of us, as it ran in our approximate direction but at an acute angle with the shore line. I first saw the animal just as it reached the edge of the water. It appeared to both of us that the vole actually ran over the surface of the water, almost without losing speed, for about 3 feet before sinking slightly and starting to swim. The water over which the vole skimmed so rapidly was found to be about 4 inches deep. There was a little floating vegetation (mostly dead leaves), but most of the area crossed was open water. After starting to swim, the vole swam under a log that projected from the shore out over the water. It swam along under this log to shore where it hid under the log. When the log was lifted the vole again entered the water and swam away from shore at an angle of about 45 degrees. Cantrall pursued the vole, and when he was about 6 feet behind it the animal dived and swam under water for a distance of about 10 feet. The water there was about two feet deep. The vole reappeared beneath the branches of a dead buttonbush (*Cephalanthus occidentalis*), but as Cantrall pursued it the animal swam for about 10 feet parallel to the shore line, then swerved toward the shore. The vole was tiring rapidly as it approached shore, and I caught it about 6 feet off-shore. The distance from the point at which the vole entered the water to the point at which it would have touched shore again was about 68 feet, so it undoubtedly swam between 80 and 90 feet. The fur of the underparts and mid-dorsal line of the captured animal were water-soaked, but that on the lateral surfaces was quite dry and fluffy. At neither of the occasions when the animal entered the water did that seem the only available avenue of escape. The vole was given to the University of Michigan, Museum of Zoology.

The proneness of the meadow vole to enter water that this record seems to indicate does not seem to be generally known, although Stone and Cram (American Animals, p. 114, 1905) wrote that they "dive and swim for short distances under water."—W. FRANK BLAIR, *Laboratory of Vertebrate Genetics, University of Michigan, Ann Arbor, Mich.*

MEADOW MOUSE TRAPPED BY PLANT STALKS

The following incident may be of interest, coming after the note on the same subject by W. J. Hamilton in the *Journal of Mammalogy*, vol. 20, page 110, February, 1939. On March 6, 1939, while trapping in a marshy, fallow field near Loch Raven, Baltimore County, Maryland, I found a young meadow mouse (*Microtus pennsylvanicus*) caught by the right hind leg in a ball of dead and decaying plant stalks at a point where two of the numerous, well-cleared runways joined. Apparently recent rains had washed the mass of debris, composed mostly of the stalks of goldenrod, asters, and wild carrot, into the runway. When found, about ten o'clock in the morning, the mouse was still

quite lively. I watched it for some time without moving. It crouched, staring back at me with clear, healthy eyes. When I approached it made strenuous efforts to escape and squeaked vigorously. In skinning it was found that the right hind leg had been broken just below the knee joint, the bones of the lower leg being entirely exposed, and the foot hanging by a mere thread of skin. It seems likely that in a short time the animal might have broken loose, leaving the foot behind. There was no evidence that there had been any attempt to escape other than by pulling away.—C. HAVEN KOLB, JR., *The Natural History Society of Maryland, Baltimore, Maryland.*

NORTHERN PINE MOUSE IN MINNESOTA

A series of specimens given to the University of Minnesota by Mr. P. F. Allan includes a skin of a pine mouse, *Pitymys pinetorum* subsp.? It is without skull, and is labeled: "Minn.: Houston Co.: Caledonia /P. F. Allan number 3, March 21, 1935, ♀ ad." The identification was verified by Dr. W. H. Osgood, of the Field Museum of Natural History.

So far as known, this is the first specimen of the pine mouse obtained from within the boundaries of the state.—DONALD M. HATFIELD, *Economic Zoology, University of Minnesota, St. Paul, Minnesota.*

NOTES ON THE HOUSE MICE OF CALIFORNIA

In recent studies of *Mus* in the collections of the Museum of Vertebrate Zoölogy at Berkeley, California, several interesting facts have been brought to light. They may be summed up in a few words without publication of the tedious statistics from which they spring.

The Museum of Vertebrate Zoölogy has a collection of 129 *Mus* from California. These animals exhibit a great variation in morphological characters; so much so, in fact, that thirty or more different types may be recognized. These types vary from one another in shade of pelage and in bodily proportions as much as the races of *Peromyscus* that one finds in the West. The obvious geographical instability in many instances, and the fact that the house mouse is, by nature, an extremely variable mammal leads me to feel that it would be unadvisable to name any new races at present.

The genus *Mus* seems to be distributed under commensal and feral conditions over the whole of California except in the highest Sierras and the remotest parts of the Mohave Desert. The large uniform grey type, that we are accustomed to call *Mus musculus musculus*, has been taken at the extreme north, extreme south, intermediate, desert, and mountainous parts of the state. Generally speaking the other forms are more restricted. Those with a high degree of red pigment are found principally in humid regions. Contrary to what I expected, the strictly bi-colored animals (i.e., lacking strong color on the bellies and usually darker above) are from humid regions centered about San Francisco Bay. As expected, the animals with noticeably low development of black pigments were taken under fairly arid conditions at the upper and lower ends of the San Joaquin Valley. However, these series are too small to carry much weight.

So far as can be seen there is no correlation of characters *inter se*. In western Europe the larger forms are, with a few noticeable exceptions, of the uniform grey type (i.e., *M. m. musculus*). In California, the larger animals exhibit many degrees of pigment concentration and development. In Eurasia, the lighter, browner races usually have shorter tails. Although a critical analysis of the tail ring count and vertebrae count has not been made, the actual and relative lengths of Californian *Mus* tails does not appear to bear any relation to the various pelage phases found in the state.

The available collections of *Mus* in America are small, but they are growing. The above résumé seems worth recording; and the confusion it indicates will probably be

dispersed little by little as collections are augmented.—DAVID G. NICHOLS, *1713 Dwight Way, Berkeley, California.*

THE DUSKY POCKET MOUSE IN IOWA

A female pocket mouse was taken near Randolph, Fremont County, Iowa (1), on September 7, 1935. This specimen has been identified by Professor M. H. Swenk of the University of Nebraska, as *Perognathus flavescens perniger* Osgood, a race distinguishable from *P. f. flavescens* (Merriam) by its darker coloration, the "rich buff of the upperparts much obscured by a wash of bright black, and the underparts chiefly rich, buffy ochraceous" (Vernon Bailey, North Amer. Fauna, no. 49, p. 121, 1926). The type specimen was taken at Vermilion, Clay County, South Dakota (2), (Osgood, Proc. Biol. Soc. Wash., vol. 17, p. 127, 1904). Numbers in parentheses refer to localities indicated on the map, figure 1.

Vernon Bailey (1926, pp. 121–122) reported specimens of *perniger* from Hankinson, Lidgerwood, and Blackmer, Richland County (3), Napoleon, Logan County (4), Finley, Steele County (5), and Parkin (now Breien) Morton County (6), North Dakota, and from Elk River, Sherburne County, Minnesota (7). Bernard Bailey (Jour. Mamm., vol. 10, p. 160, 1929) also recorded it from Sherburne County, Minnesota.

Polderboer (Proc. Iowa Acad. Sci., vol. 44, p. 199, 1937) reported collections of *Perognathus flavescens* from Union Township, Blackhawk County, Iowa (8). Although he did not refer his specimens to a subspecies, his statement that "the belly and sides are ochraceous yellow" would indicate that he had taken *P. f. perniger*. Scott (Iowa State Coll. Jour. Sci., vol. 12, no. 1, p. 73, 1937) recorded specimens of *perniger* collected at Guthrie Center, Guthrie County (9), and Oakland, Pottawattamie County (10), Iowa. Polderboer has informed me that in August, 1938, he collected four pocket mice "in the vicinity of Backbone State Park, Delaware County, Iowa" (11). Thomas G. Scott of Iowa State College has identified these specimens as *P. f. perniger*.

I am indebted to Mr. Emmett B. Polderboer and Dr. Thomas G. Scott, both of Iowa State College, for permission to report here the collection and identity of the Delaware County, Iowa, specimens.

These Iowa records indicate an eastward and southward extension of the range of *P. f. perniger* given by Vernon Bailey (1926, p. 121), and an eastern extension of the limits of distribution of pocket mice of the subgenus *Perognathus* as given by Osgood (North Amer. Fauna, no. 18, p. 71, 1900).

Osgood (1904, p. 128) reported two adults of *P. flavescens* from Verdigre, Knox County, Nebraska (12), as being "distinctly intermediate" between *P. f. flavescens* and *P. f. perniger*, but apparently he considered them referable to *perniger*. All reported collections of typical *perniger* have been made east of the Missouri River, with one exception. Vernon Bailey (1926, pp. 121–122) "picked up a dead one in the town of Parkin" (now Breien), North Dakota (6), and "found many of their characteristic burrows and tracks in sandy ground". According to present knowledge it appears, however, that in all except the northernmost portion of its range, true *perniger* is confined to lands east of the Missouri River.

In his North Dakota report on pocket mice of this subspecies, Vernon Bailey (1926, p. 122) said that "sandy prairie soil is their favorite habitat". Bernard Bailey (1929, p. 160) reported *perniger* as "fairly common in the sand-dune region" of Sherburne County, Minnesota. Polderboer's Blackhawk County, Iowa, specimens were taken in "sandy prairies." The Randolph, Iowa, specimen here reported was taken in a potato patch on Tama silt-loam soil.—EDSON FICHTER, *University of Nebraska, Lincoln, Nebraska.*

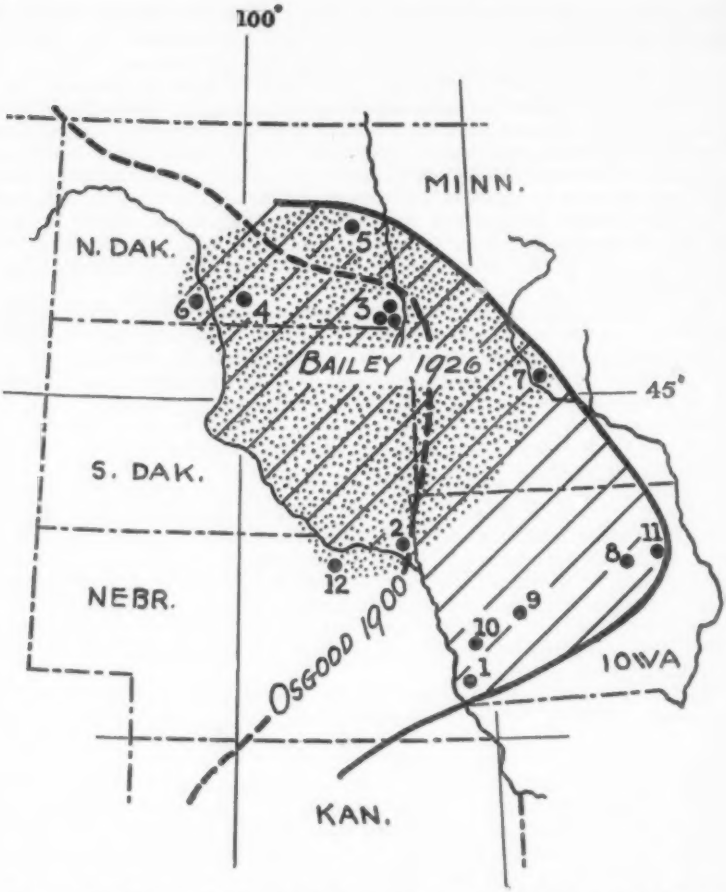


FIG. 1. Distribution of *Perognathus flavescens perniger*. Numbered dots indicate known localities of record, stippled area the distribution as known in 1926, diagonally lined area the distribution as known at present. The heavy broken line indicates the eastern limit of distribution of the subgenus Perognathus as known in 1900, solid line the eastern limit as known at present.

RE-ASSIMILATION OF FOOD BY THE BANNER-TAIL KANGAROO RAT

On March 8, 1939 while on a brief field excursion to Van Horn, Texas I set out a short line of snap and live traps for banner-tail kangaroo rats (*Dipodomys spectabilis baileyi*).

During the night these traps produced, among other rodents, one dead and three

live specimens of banner-tails. I was more than a little amazed to discover that the cheek pouches of the dead specimen contained, in addition to a few flakes of the rolled oats which had been used as trap bait, only the basal sections of two dead stalks of grass and about fifteen dry and weathered kangaroo rat droppings. The inference that these droppings had been accumulated for food was substantiated by the fact that each of the can traps in which the live specimen were taken contained a nearly equal number of similar droppings. It was obvious they had been carried there in the cheek pouches of the captives and then expelled during the fright of capture.

It may be noted that the Van Horn area, at this season, is so sterile and devoid of suitable food that, despite the banner-tail's habit of laying up stores in times of plenty, the survival of the animal in that region may very well be predicated on an ability to find sustenance in the re-assimilation of fibrous material remaining in previously ejected feces.—F. W. Miller, *Dallas Museum of Natural History, Dallas, Texas.*

ATTACKS ON PORCUPINE BY GRAY FOX AND WILD CATS

Seton tells us in "Lives of Game Animals" that the gray fox (*Urocyon cinereoargenteus*) is not "shy and cowardly" and when matched with anything equal in size will probably "come out free of the taint of cowardice." He includes porcupines in the list of food of the fox, but makes no mention of the methods used in securing such prey.

On March 11, 1939 a weakened female gray fox was found along Mink Brook near Hanover, New Hampshire. When supplied with suitable food, she failed to respond and finally died. Upon dissection it was found that she had had an encounter with a porcupine and was suffering the consequences. Her foreparts, especially the legs and mouth region were filled with fresh quills. Some had also worked into the intestinal region where they had punctured the organs many times, especially the stomach. No food was found in any part of the alimentary canal and all fat had been used. The skin adhered tightly to the flesh. Her death was immediately due to starvation, evidently as a result of the quills.

Contrasted with this, two male wildcats (*Lynx rufus*) captured March 10 and 12 on Mt. Cardigan, New Hampshire, had likewise encountered procupines but fared better than the fox. In the case of the cats, the quills had lodged in much the same places, but were located lengthwise under the skin and were in a softened condition. None could be found in the body cavities. The extensive scar tissue around some of the quills, indicated that they must have been there a long time.—Richard Lee Weaver, *Dartmouth College, Hanover, N. H.*

NOTES ON THE SIERRA NEVADA FLYING SQUIRREL

On June 16, 1938, at Camp Curry, in Yosemite Valley, California, I captured a Sierra Nevada flying squirrel (*Glaucomys sabrinus lascivus*) in a Potter two-cell bird trap. It was in the trap when I awakened at about 5:00 a.m. When I released the squirrel, at 6:15 a.m., it went up to the top of a nearby yellow pine and from there glided across to a much larger tree about 50 feet away.

Several evenings later, at about 8:00 p.m., a scratching noise on a yellow pine close to the side of the tent attracted my attention to the squirrel which was coming down the tree head first. After watching me for several minutes it came into the tent and ate some stale cornbread muffins. After feeding for about five minutes it took a piece of one of the muffins and went back up the same tree. The next evening, again at 8:00 p.m., presumably the same flying squirrel, repeated the performance of the previous evening. This it did every evening for the ensuing two weeks of my stay, always between 8:00 and 8:15.—Vincent Mowbray, *5052 Fairfax Ave., Oakland, California.*

THE HAND CAPTURE OF CONIES

As has been discovered by collectors who have tried to trap conies (*Ochotona*), these animals are preeminently creatures of fickle appetite. At certain times they may easily be tolled into live or snap traps with such baits as rolled oats, carrots, apples and fresh herbage or, as has recently been reported in this Journal, with dried prunes. On other occasions no bait, however delectable, will tempt them. In my experience with a number of races of these interesting alpine animals in several of the higher ranges of Colorado and Wyoming, there is a possibly new, or at least hitherto unreported, method of taking live specimens. It was discovered quite by accident in 1920 and has been successfully utilized on many occasions since that time. For want of a better name it may be designated as "hand capture." For the successful prosecution of this method, patience and agility are prime requisites and, in no less degree, the careful selection of the terrain of operation. Ideally one should select a rock slide supporting a goodly population, bordered by gently sloping meadows where the conies have been accustomed to forage and over which are scattered a few rock slabs and boulders of small dimension.

The prospective cony catcher should then place himself in a position of vantage up hill, and quietly sit down. If all goes well a cony will shortly appear and in due time venture out onto the meadow to feed. As soon as it has left the security of its rock-slide citadel a reasonable distance behind, the hunter leaps to his feet and rushes forward in an effort to cut off its retreat. This is not difficult to do for the cony is easily confused and will dodge under the first bit of boulder which will afford cover. When once so isolated the work of capture consists of stopping off all avenues of escape and then digging under until the animal is reached. If the boulder is small enough it can be flipped over and the animal taken by surprise. By these practices five conies have been secured in as many hours.

The cony's reactions to capture of this kind are extremely variable; some submit quite docilely, others struggle so violently that they die from exertion and shock almost as soon as they are in hand. It is only infrequently that they will attempt to bite, but I well remember my first experience with a biting cony. This was an old male (*Ochotona princeps ventorum*) caught high in the Absaroka Mountains of Wyoming in 1924. It had been safely taken when it suddenly used its teeth with such vigor and effectiveness as to insure its instantaneous release.—F. W. MILLER, *Dallas Museum of Natural History, Dallas, Texas.*

HIGHWAY MORTALITY OF RABBITS IN IDAHO

The unusually large number of rabbits killed by automobiles on sections of U. S. Highway 30 in Idaho has attracted the attention of other observers. Gordan (1932), during the summers of 1929 and 1931, made an approximate count of 100 rabbit carcasses per mile in a 2 to 3 mile stretch of road near Thousand Springs and recorded some sagebrush sections as having averages as high as 16 carcasses per mile. In September 1932, Sperry (1933) found the greatest rabbit loss (212 carsasses) in the first 15 miles south of Boise. This area averaged 14 carcases per mile at that time.

On August 10 to 11, and again on August 12 to 13, 1938, the writers covered the areas where Gordan and Sperry observed the greatest rabbit mortality. In a stretch of 6 miles of road passing the Thousand Springs, the automobile had to be slowed to almost a stalling stage in order to count all the carcasses. On August 10, the count for the whole 6 miles was 264, and on August 13, the counts per mile were 49, 220, 89, 44, 27, and 4, averaging 72 carcasses per mile. These rabbits, however, were all but 4 that were noted on the whole river valley highway between Hammett and Twin Falls. On the 15 miles of road south of Boise, where Sperry found rabbit carcasses, averaging 14 per mile in

1932, the writers counted only 29 carcasses, an average of slightly more than 2 per mile. The next 30 miles south, however, averaged 13 carcasses per mile; it may be that there occurred a shifting of population because of some unknown cause.

A complete tabulation of counts between towns is presented in the following table to permit comparison with possible future counts. (Figures in parentheses are averages.)

The counts made August 13 to 14 were accompanied by brief notes on the character of the land and vegetation for each mile. A study of these brought out several relationships thought to be important in explaining the spotty distribution of carcasses along the highway.

(1) Counts totaled 1,209 rabbit carcasses in the 194 miles between Nyssa, Oregon, and Twin Falls, Idaho. Of this distance the 134 miles that were without fatalities were

TABLE

SECTIONS COUNTED	MILES	CARCASSES	
		Aug. 10-11	Aug. 13-14
Between:			
Tremonton and Snowville, Utah	40	23(.6)	Not counted
Snowville and Strevell, Utah	27	67(2.5)	Not counted
Strevell, Utah, and Declo, Idaho	28	38(1.3)	Not counted
Declo and Burley, Idaho	9	0(0)	Not counted
Burley and Twin Falls	44	58(1.3)	Not counted
Twin Falls and Buhl	18	0(0)	0(0)
Buhl and Hagerman (Thousand Springs)	22	264(12.0)	433(19.7)
Hagerman and Glenn's Ferry	30	0(0)	4(.1)
Glenn's Ferry and Hammett	9	0(0)	0(0)
Hammett and Mountain Home	18	232(13.)	263(14.6)
Mountain Home and Eureka	13		245(19.)
Eureka and Mayfield	10		131(13.1)
Mayfield and Oasis	7	510(11.6)	55(7.8)
Oasis and Boise	14		29(2.1)
Boise, Idaho, and Nyssa, Oregon	53	56(1.0)	49(.9)
Total	364	1,282(3.5)	1,209(5.9) (194 miles)

mostly in river valleys and agricultural areas. Some sagebrush land was included, however. The remaining 60 miles had concentrations as follows: 24 miles with 1 to 10 carcasses, averaging 4 per mile; 32 miles with 11 to 40 carcasses, averaging 22; and 4 miles with 41 to 100 plus carcasses, averaging close to 100. The first category falls largely within areas bordering cultivation and towns; the second, in favorable sagebrush stretches; and the third, at Thousand Springs, where evidently an abnormal condition prevails. These figures are felt to be significant in showing the relative distribution of carcasses on the highway when land types are considered.

(2) Sagebrush plateaus held the greatest concentrations of rabbit carcasses per mile over long stretches of highway. There was an apparent relation between the mortality and the density of sagebrush and its understory, the optimum invironment seeming to consist of open sagebrush and a scattered understory of grasses and other herbaceous plants. In areas where grasses were dominant or lacking, owing possibly to overgraz-

ing, a decline in mortality of rabbits was noted. Approximately 59 per cent of all the carcasses observed were in the sagebrush environment.

(3) A lessening of mortality was apparent close to towns and cultivated areas. Twenty-four miles were recorded with fewer than 10 carcasses per mile. Of these, 19 miles were either in cultivated areas or within 3 miles of a town. All such miles were on the edges of larger concentrations of carcasses. Only 7 per cent of the total rabbit mortality was noted in these combined environments.

(4) River valleys were extremely low in highway mortality, even though green foods were apparently abundant. Only 4 carcasses, excluding the abnormal condition at Thousand Springs, were noted on the river valley road between Hammett and Twin Falls, Idaho, a distance of 79 miles. The fact that much of this area is under cultivation and without extensive sagebrush may be a contributing factor to the low mortality.

(5) The extremely high number of dead rabbits (433) in a 6 mile stretch at the Thousand Springs is felt to be correlated in some manner with the presence of the Lost River outlets. The area is one of sparse sagebrush and grass between the Snake River and the valley hills. It differs little, except for the springs, from other sections of the valley road. Whatever the responsible factor is in this area, it probably indirectly causes the death of well over a thousand rabbits each year. This 6-mile stretch accounted for 34 per cent of the fatalities noted in 194 miles.

No attempt was made to obtain separate counts for the various species of rabbits involved. Both *Lepus townsendii* and *L. californicus* occur in areas through which highway 30 passes and the carcasses noted were predominately of those species. Some cottontail (*Sylvilagus nuttalli*) fatalities were observed, particularly in the Thousand Springs area. It is unlikely that a significant percentage of the losses involved the Idaho brush rabbit (*Brachylagus idahoensis*), since the diurnal habits of this species probably protect it to a large extent from dangers of the highway.

LITERATURE CITED

GORDAN, KENNETH, 1932. Rabbits killed on an Idaho highway. Jour. Mamm., vol. 13, no. 2, p. 169. May.

SPERRY, CHARLES C., 1933. Highway mortality of rabbits in Idaho. Jour. Mamm., vol. 14, no. 3, p. 260. August.

CECIL S. WILLIAMS and MARCUS C. NELSON, *Bear River Migratory Refuge, Bureau of Biological Survey, Brigham City, Utah.*

A CORRECTION

Mr. Claude W. Hibbard, of the University of Kansas Museum, has called my attention to the fact that the bat referred to in "Hawks as Enemies of Bats" in the May, 1939, issue of the Journal of Mammalogy, p. 252, was probably *Tadarida mexicana* instead of *T. cynocephala*. Mr. Hibbard has made extensive studies of the bats of the Marehew Cave, Woods Co., Oklahoma, the bat cave referred to in my note, which is located just across the boundary from Aetna, Kansas.—RALPH W. MACY, *St. Thomas College, St. Paul, Minnesota.*

TWENTY-FIRST ANNUAL MEETING OF THE AMERICAN SOCIETY OF MAMMALOGISTS

The twenty-first annual meeting of the American Society of Mammalogists was held at Leche Hall, Louisiana State University, Baton Rouge, from April 3 to 7, 1939. There were 92 members and visitors present, representing 19 states, the District of Columbia, and one Canadian province.

PROGRAM

MONDAY, APRIL 3

8:00 *p.m.*

Meeting of the Board of Directors, Hotel Heidelberg

TUESDAY, APRIL 4

10:30 *a.m.*

1. Address of welcome. Col. Troy Middleton, Dean of Administration, Louisiana State University.
2. Response by sectional delegates. Dr. M. W. Lyon, Jr. and George Willett.
3. Life-zones. Walter P. Taylor, U. S. Biological Survey.
4. Factors affecting the geographic distribution of mammals in Oklahoma. W. Frank Blair, Univ. of Michigan.
5. Elephant seals. Ed. N. Harrison, Encinitas, California. Motion pictures in colors; comments by W. H. Burt.

2:15 *p.m.*

Annual Business Meeting of the Society

4:00 *p.m.*

6. Range of the Coati-mundi in the United States. F. Wallace Taber, Texas A. and M. College.
7. Hunting mountain lions with the camera. Stanley P. Young, U. S. Biological Survey. Slides.
8. Preliminary report on a study of the giant panda. D. D. Davis, Field Museum of Natural History. Introduced by Karl P. Schmidt.

7:00 *p.m.*

The members of the Society, their wives and friends were entertained at an open house and buffet supper at the Westdale Country Club.

WEDNESDAY, APRIL 5

9:00 *a.m.*

9. Variation in *Peromyscus polionotus*. Arthur H. Howell, U. S. Biological Survey. Slides.
10. Additions to our knowledge of the Recent mammals of Idaho. (Included first showing of Davis's "Recent Mammals of Idaho.") E. Raymond Hall, Museum of Vertebrate Zoology.
11. The third record of the dusky pocket mouse (*Perognathus flavescens perniger* Osgood) from Iowa. Edson Fichter, Univ. of Nebraska. Introduced by Otis Wade. Slides.

12. Contributions to a knowledge of the smaller ground squirrels of the Pacific Northwest. Theo. H. Scheffer, U. S. Biological Survey. (Read by title and 5 minute abstract.)
13. Geographic variation in the kangaroo rat, *Dipodomys microps*. E. Raymond Hall, Museum of Vertebrate Zoology. Slides.
14. Electrical recording of the activities of small mammals. Donald A. Spencer, U. S. Biological Survey. Demonstrations.
15. How common are mammals? Carl O. Mohr, Illinois Natural History Survey. Slides. (Read by title.)
16. Original descriptions of mammals. E. A. Goldman, U. S. Biological Survey.
17. Summer food of gray foxes at Camp Lee Quail Reserve, Virginia. A. L. Nelson, U. S. Biological Survey, and C. O. Handley, Virginia Cooperative Wildlife Research Unit. Slides.

11:45 *a.m.*

Members of the Society assembled on the steps of Leche Hall for a group picture.

2:15 *p.m.*

18. Notes on food habits of coyotes on the Wichita Mountains Wildlife Refuge, Oklahoma. Charles H. Rouse, U. S. Biological Survey.
19. Color phases of the red fox (*Vulpes fulva*) in Ontario. E. C. Cross, Royal Ontario Museum of Zoology. Slides.
20. The evolution of predator control policy in the National Parks. Victor H. Cahalane, National Park Service.
21. Breeding habits and growth rates of beaver. G. W. Bradt, Michigan Department of Conservation. Slides.
22. Opossum population studies in Texas. Dan W. Lay, Texas Game, Fish and Oyster Commission.
23. Observations on the ecology of the Louisiana muskrat marshes. John J. Lynch, U. S. Biological Survey.
24. Comments on the Louisiana muskrat. Ted O'Neil, Louisiana State University.
25. Development of the fox squirrel den. Luther L. Baumgartner, Ohio Cooperative Wildlife Research Unit.
26. Red squirrel activity and its relation to census methods. W. J. Hamilton, Jr., Cornell University. Slides. (Read by title.)
27. Labrador Life. J. Kenneth Doutt, Carnegie Museum. Motion pictures.

7:00 *p.m.*

The Annual Dinner of the Society was held at Highland Hall on the University Campus, after which a motion picture was presented by Mr. Edward A. McIlhenny showing the methods employed by the early day plume hunters in securing egret feathers for the market.

THURSDAY, APRIL 6

9:00 *a.m.*

Symposium on southern mammals. W. P. Taylor presiding

28. Mammals of Texas. W. B. Davis, Texas A. and M. College.
29. Mammals of Louisiana. George H. Lowery, Louisiana State University.
30. Mammals of Mississippi. Fannye A. Cook, Mississippi Game and Fish Commission.
31. Mammals of the southeastern states. E. V. Komarek, Thomasville, Georgia.

1:45 *p.m.*

32. Mammals of Florida. E. S. Sherman, University of Florida.
33. The time of emergence of ground squirrels from hibernation in relation to soil temperature and weather conditions. Otis Wade, University of Nebraska.
34. The blood sugar concentration in active and hibernating ground squirrels. R. A. Lyman, Jr., University of Nebraska. Introduced by Otis Wade.
35. Variations in house mice (*Mus musculus*). David G. Nichols, Berkeley, California. (Read by title.)
36. A preliminary study of the home range and territory of the cotton rat (*Sigmodon hispidus hispidus*). Roland Abegg, Louisiana Department of Conservation.
37. Travelling of jumping mice in Vermont. Carolyn Sheldon, Woodstock, Vermont. (Read by title.)
38. Spread of the armadillo in Texas. F. Wallace Taber, Texas A. and M. College.
39. Weights and measurements of white-tailed deer. Earl Sanders, Texas Game, Fish and Oyster Commission. Slides.

3:45 *p.m.*

Final Business Meeting of the Society

FRIDAY, APRIL 7

Members and friends spent a very enjoyable day as guests of Mr. Edward A. McIlhenny at his estate on Avery Island, Louisiana. En route the renowned Evangeline country was visited. On Avery Island Mr. McIlhenny guided the party through the famous "Jungle Gardens" and "Bird City."

At the meeting of the Board of Directors on April 3, Dr. W. Reid Blair was re-elected as trustee for 1939–1941. Mr. A. H. Howell announced his resignation as Chairman of the Index Committee and was re-appointed as Chairman of the Editorial Board.

At the annual business meeting on April 4, Hartley H. T. Jackson was unanimously re-elected as President. It was then moved, seconded and passed that the rules be suspended and the remaining officers be reinstated for another year as follows: Vice-presidents, A. Brazier Howell and Walter P. Taylor; Recording Secretary, Robert T. Orr; Corresponding Secretary, William B. Davis; Treasurer, Viola S. Schantz. The following additional directors were elected: J. Kenneth Doutt, William H. Gates, E. Raymond Hall, William J. Hamilton, Jr., and Remington Kellogg.

It was with deep regret that the Society learned of the deaths of 13 members, three of whom were charter (*) members: S. Prentiss Baldwin, William Bebb, Carlos C. Goff, Earl E. Hoover, Karl A. Jacobson, Nathaniel T. Kidder, Arthur N. Leeds, John N. Lowe, William I. Lyon, *Norman McClintock, *John C. Phillips, *T. Wingate Todd, Jan Versluys.

The following is a summary of the report of the Corresponding Secretary:

	1938	*1939*
New members elected at annual meeting	106	79
New subscriptions received since last meeting	29	20
Total gross additions to mailing list	135	95
Resignations	16	19
Deaths reported	13	13
Subscribers delinquent (suspended)	9	37
Annual members dropped for delinquency	33	40
Annual members delinquent two years	41	36

	1938	1939
Annual members delinquent one year	71	106[1]
Total gross loss to mailing list	183	253
Number of honorary members	4	4
Number of life members	52	50
Number of annual members in good standing	701	661
Total number of delinquent members	112	142
Total number of members	869	857
Members not receiving Journal (addresses lost)	3	3
Number of paid subscribers	197	183
Total mailing list at this date	951	902

[1] The fact that the meeting was held one month earlier than usual may account in part for the large number of delinquents.

An invitation to hold the 1940 annual meeting of the Society at Toronto, Canada was accepted.

A Local Committee on Arrangements for the 1940 meeting was appointed as follows: E. C. Cross, chairman, R. M. Anderson, A. F. Coventry, J. H. Fleming, W. E. Saunders, and L. L. Snyder. An invitation for the holding of the 1941 meeting at Chicago was also read, but no action was taken.

Reports of the following standing committees were read and accepted: Editorial, Life History and Ecology, Conservation. No report was read by the Committee on Bibliography but it was unanimously agreed that a vote of commendation be given the members of this committee for the fine results shown in current issues of the Journal.

As an expression of the appreciation for the courtesies extended to the American Society of Mammalogists at its Twenty-First Annual Meeting, the following resolution was adopted.

Resolved that the thanks of the American Society of Mammalogists be tendered to His Excellency, Governor Richard Leche, to the administrative officers and faculty of the Louisiana State University, and their assistants, to the local committee on arrangements, to their wives, and to Mr. E. A. McIlhenny, for the hospitality enjoyed, for their effective arrangements, and for the program which has resulted in an outstandingly instructive and enjoyable meeting.

In addition at the final business meeting on April 6 the following six resolutions were passed:

WHEREAS, it is the practice of certain State Departments of Conservation to introduce certain species or subspecies into areas already sparingly occupied by closely related forms,

THEREFORE, be it resolved by the American Society of Mammalogists that such practices be discontinued in favor of a program of protection and restoration of the native mammals present.

WHEREAS, past editions of 'A list of North American Mammals in the United States National Museum' have constituted check lists of great value to mammalogists throughout the world, and

WHEREAS, the last edition of sixteen years ago is out of print and is now practically unobtainable.

THEREFORE, be it resolved that the American Society of Mammalogists suggests to the Director of the National Museum that a revised edition be published at an early date.

WHEREAS, the Society has learned of the importance to wild life of the Singer Sewing Machine tract, located in Madison Parish, Louisiana, in which is found a wide variety of mammals and birds, including wolves, bears, mountain lions, deer, and ivory-billed woodpeckers,

THEREFORE, be it resolved that it is the feeling of the Society that this area should be reserved by the State or Federal Government as a wilderness area and wildlife refuge.

RESOLUTION RELATING TO PREDATORY-PREY REGULATIONS IN NATIONAL PARKS

The Society has learned that:

1. The California legislature has memorialized Congress and the President to force the National Park Service to carry on coyote control in the national parks of California.
2. The Alaska Territorial Legislature has memorialized Congress and the President to force the Service to control wolves and coyotes in Mount McKinley National Park and Glacier Bay and Katmai National monuments.
3. Certain other organizations and individuals have brought pressure to bear to the end that predator control would be a required activity in areas under the administration of the Park Service.
4. That efforts to enforce predator control as an obligation are being made despite indications that park predators are not working to the detriment of prey species within the parks and are causing no serious losses to economic interests outside the park boundaries.

Therefore, the American Society of Mammalogists urges that the National Park Service refrain from reducing any native species of carnivore unless and until necessity therefore is shown in each case as the result of an adequate scientific investigation by competent and trained biologists.

RESOLUTION REGARDING WILD LIFE IN NATIONAL PARKS

Part I

WHEREAS, The American Society of Mammalogists has learned of the bill pending in Congress to allow the National Park Service to dispose of surplus deer, elk, moose and bears from the several parks and monuments where ranges have become overstocked,

THEREFORE, be it resolved, that the American Society of Mammalogists, does hereby urge the President of the United States, members of the House of Representatives, and the United States Senate to authorize the Secretary of the Interior to dispose of surplus animals mentioned above inhabiting the national parks and national monuments.

Part II

WHEREAS, The American Society of Mammalogists has been requested for comments on the situation in Death Valley National Monument where non-native burros are seriously threatening the existence of the rare desert bighorn in that monument,

THEREFORE, be it resolved, that the American Society of Mammalogists does hereby urge the National Park Service to dispose of such burros as are interfering with proper preservation of the bighorn and other native species of the fauna and flora of the monument.

RESOLUTION AGAINST THE USE OF POISON, ESPECIALLY BY C. C. C. ENROLLEES AND W. P. A. EMPLOYEES

The American Society of Mammalogists regrets the use of poison against native wild mammals, except in case of an emergency such as may occur, for example, in some outbreaks of rabies, and

Especially regrets any use of poison baits by C. C. C. enrollees or W. P. A. workers, and urges the governmental agencies supervising these workers to employ other methods when control is necessary, and

Further urges that control measures, of any kind, against native wild mammals be undertaken only where scientific investigation, made in advance, shows the necessity for reduction of numbers of mammals.

REVIEWS

Allen, Glover Morrill. BATS. 6 + 368 pp., 57 figs. and frontispiece. Harvard University Press. Cloth, $4.00.

Bats in all ages have been a source of wonder and superstition. In modern times much attention has been directed to studies of their habits and characteristics. The results of such studies have appeared for the most part in scientific journals.

In this book the main facts about bats are presented for the first time in complete and orderly fashion, supplying answers in simple language to almost any question that may arise concerning these interesting creatures. Dr. Allen apparently has combed the literature carefully, and has brought together a vast amount of information on almost every conceivable aspect of the life of bats. To this he has added his own wide experience in the study of these animals, both in the field and in the laboratory.

The subject is fully treated under a number of heads, which may be indicated by citing the titles of some of the chapters, as follows: Bats in folklore; bats as pets; bats as food; where bats hide; what bats live by; color in bats; bats teeth and their meaning; an ancient lineage [their evolutionary history]; the geographic distribution of bats; social habits of bats; breeding habits and young of bats; migrations of bats; hibernation of bats; the enemies of bats; the parasites of bats; bats in relation to disease.

Common names are provided for most of the species mentioned—as well as for the 17 families of bats of the world—8 families confined to the Old World, 6 to the New World, and 3 common to both hemispheres.

The appended bibliography appears to be complete with the exception of all references beginning with the letter "D," which should include a number of citations, as Dobson, Dunn, Ditmars, etc.—A. H. HOWELL.

Allen, Glover M. A CHECKLIST OF AFRICAN MAMMALS. Bull. Mus. Comp. Zoology at Harvard College, vol. 83, 763 pp. February, 1939.

Almost simultaneously with his "Mammals of China and Mongolia" [see Osgood, Jour. Mamm., vol. 20, p. 113, 1939], Doctor Allen brings out a second comprehensive work: a remarkable achievement. The checklist covers all the species and subspecies of mammals found in continental Africa, on the island of Madagascar, and the islands of the Mascarene group; it also includes the seals, whales, and sirenians that occur along the African shores, and in the adjoining waters of the Atlantic and Indian oceans, and the Mediterranean. The list of names admitted as valid, and of those regarded as synonyms, is so complete that I have found very few obvious omissions; on the contrary, I have discovered in it a considerable number of references which have been previously overlooked, even in comprehensive revisions. The arrangement of the genera within the subfamilies, and that of the subspecies within the species, is alphabetical; but the type species of each genus, and the typical subspecies of each species is always placed first. This is a list only, without actual descriptions or life histories. It gives accurate citations of the original descriptions with the dates minutely ascertained; it also quotes revisions of groups, and authoritative statements fixing the status of certain forms.

The ranges are described as far as possible. No doubt, a good deal of original and critical revision has gone into the treatment of various groups; but, owing to the largely unrevised status of most genera of African mammals, the principle adhered to has been to present a general, but uncritical, summary of every named form and group, primarily for reference. This purpose has been attained in full. Every worker on African mammals will need this checklist at arms reach, and will refer to it for reliable information. The book is well printed, with remarkably few typographical errors. There is a complete index.—ERNST SCHWARZ.

Davis, William B. THE RECENT MAMMALS OF IDAHO, 400 pp., 2 pls., 33 figs. Contribution from the Museum of Vertebrate Zoology, University of California, Berkeley. The Caxton Printers, Ltd., Caldwell, Idaho, April 5, 1939. Cloth, $5.

In this attractive volume we have presented the only complete account of the mammals of Idaho, a work long needed, supplementing, as it does, the only previous report of importance on the State—Merriam's "Results of a Biological Reconnoissance of South-central Idaho" (North Amer. Fauna no. 5, 1891).

The author explains that he has not personally visited the extreme northern and the central mountainous parts of the State. He points out that information concerning the central portion is "discouragingly meager."

The geography of the State is briefly treated, with some discussion of the geological history. In considering the distributional areas in Idaho, life zones, as used by many zoologists in North America, are not considered. Instead, the term "biotic areas" is employed. The author says (p. 27): "Fifty-six kinds [of mammals] appear to be limited in their distribution primarily by climatic factors, largely temperature, while the remaining 70 kinds may be assignable to three or, possibly, five areas, the limits of which are determined not by climate alone, but by the *interaction* of climatic, geographic, edaphic, and biotic factors, each of which, alone, may affect each of the kinds of mammals differently."

The areas recognized are (1) the Northern Rocky Mountain Biotic Area, (2) the Central Rocky Mountain Biotic Area, and (3) the Northern Great Basin Biotic Area. "In addition to these three well-defined areas, two others less well differentiated (at least in Idaho) may be recognized, namely, (1) the Columbian Plateau Biotic Area, and (2) the Payette Biotic Area." Within these biotic areas, the mammals are grouped in seven "associations." The reasons for the use of this concept of distributional factors rather than the concept of life zones based largely on temperature are discussed in a chapter of 25 pages entitled "Problems of distribution in Idaho."

In this chapter, also, are discussed a number of factors that affect the distribution of certain species, as: snow, food supply, presence of safe breeding places and places of temporary refuge, competition among species and their racial history, and particularly the effect of the Snake River in limiting distribution.

In the systematic part of the work, the 141 kinds of mammals are treated under the following heads: Scientific and common name; reference to original description, with the type locality; synonyms; description; remarks; ecology; records of occurrence. Characters of the orders, families, and of many of the genera are included. Habits and ecology of the species are treated rather fully, especially in the Rodentia. Distribution maps of the groups add much to the value of the work. The gazetteer of localities in the State will prove useful to geographers.

Nomenclatural changes from current usage are few: *Lemmiscus* Thomas, for a subgenus of voles is raised to generic rank; 3 new races are described—*Citellus elegans aureus*, *Castor canadensis taylori*, and *Peromyscus maniculatus serratus*. *Callospermophilus* and *Ammospermophilus* are retained as full genera, although (on page 163) they are included in the description of *Citellus*, but with mention only of external characters.

Contrary to recent custom, *Ursus* instead of *Euarctos*, is used for the black bears. The author is inclined to doubt the validity of the race *Reithrodontomys megalotis nigrescens* Howell, in which opinion the present writer joins.

The typography is clear and attractive in appearance; no errors have been detected in a casual reading of much of the text. The author is to be congratulated on having produced one of the most complete and authoritative State lists of mammals that have yet appeared.—A. H. Howell.

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[Conducted by Gerrit S. Miller, Jr., Remington Kellogg, and Emma M. Charters.]

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COMMENT AND NEWS

As this issue goes to press we have received news of the death of two of our past presidents—Dr. Witmer Stone, who died at Philadelphia, May 24, 1939, and Dr. Joseph Grinnell, who passed away at Berkeley, California, on May 29, 1939.

By special arrangements with the publishers, the Society can offer to members in good standing Davis's THE RECENT MAMMALS OF IDAHO for $3.50, post paid (list price, $5.00). Address all communications to the Corresponding Secretary, American Society of Mammalogists.

Separates of the lists of Recent Literature appearing in each number of the Journal are available to those who desire them at a cost of 18 cents a number or 70 cents for the entire volume of 4 numbers.

Address Miss Viola S. Schantz, Treasurer, U. S. National Museum, Washington, D. C.

Mr. E. C. Cross, Chairman of the Local Committee for the next annual meeting of the Society states that the meeting will be held in Toronto, Canada, May 28 to 31, 1940. Additional details will appear in the February number.

The ninth annual Convention of the Biological Photographic Association will be held September 14–16th, at the Mellon Institute for Industrial Research, Pittsburgh, Pa. The program will be of interest to scientific photographers, scientists who use photography as an aid in their work, teachers in the biological fields, technical experts and serious amateurs. It will include discussions of motion picture and still photography, photomicrography, color and monochrome films, processing, etc., all in the field of scientific illustrating. Up-to-date equipment will be shown in the technical exhibit; and the Print Salon will display the work of many of the leading biological photographers here and abroad.

Further information about the Association and the Convention may be obtained by writing the Secretary of the Biological Photographic Association, University Office, Magee Hospital, Pittsburgh, Pennsylvania.

It is interesting to learn, from the "Fur Trade Review Weekly," for May 4, 1939, that at the recent London fur sales, 50 skins of sea otter were sold. At about the same time The New York Auction Company offered 22 and the Fouke Fur Company of St. Louis, 10 pelts of this animal. Enquiry directed to the Bureau of Fisheries, the agency in charge of the protection of marine mammals, elicited the information that these 32 pelts offered for sale in the United States were all taken in territorial waters of the Kurile Islands by the Japanese Government, and were certified in accordance with the Act of August 24, 1912, as having been lawfully taken. Now that there has been some increase in the number of sea otters, constant vigilance will be required to intercept possible bootlegging of these valuable pelts on the part of poachers.